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5, 1944
E 33, No. 12

AMERICAN

DYESTUFF REPORTER

Try them all—

Try all of the available faster-to-light direct greens in comparison with *Solophenyl Fast Blue Green B L.*

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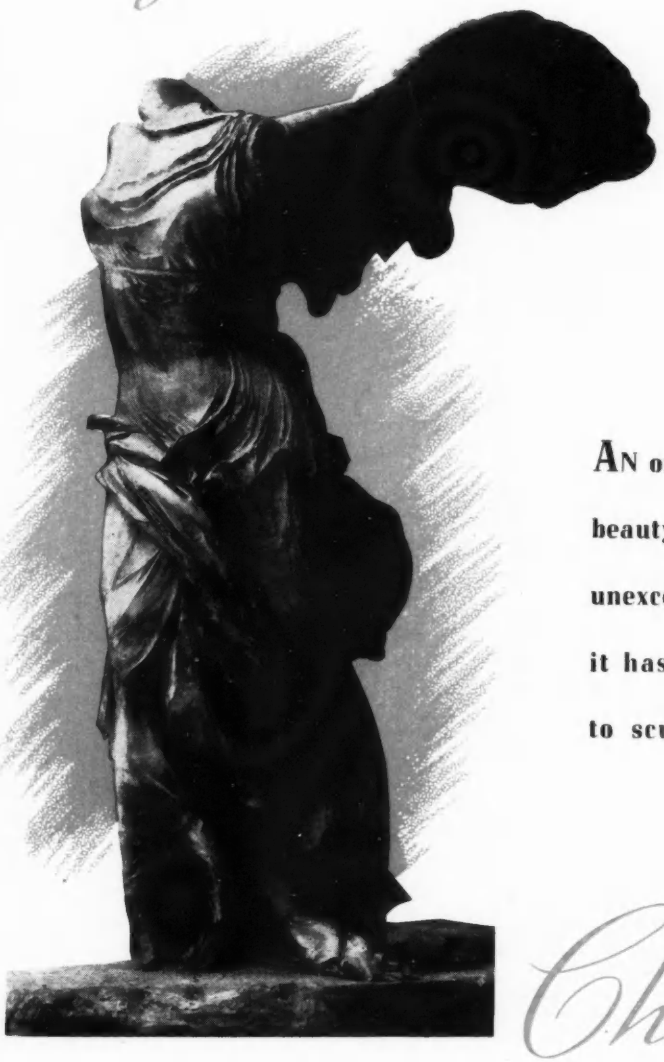
"Originals"



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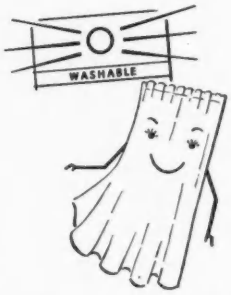
And the first test proved what a good idea that was! For in this test the sample showed shrinkage in laundering... fading in sunlight. Brandvein seized the opportunity to overcome these tendencies. They gave the go-ahead signal, and one of their licensee finishers went right to work on the problem.



Knowing the performance facts, they made a few changes in routing... a few adjustments in dye formulas... and the second sample easily met these "green light" standards:

Laundering temperature	**160° F.**
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Resistance to sunfading	**60 hours**
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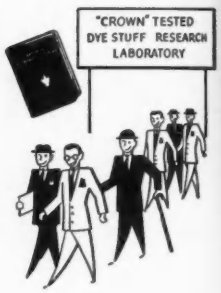

These new facilities are available to all CROWN Tested licensees. We'll be glad to discuss the details with you at any time.

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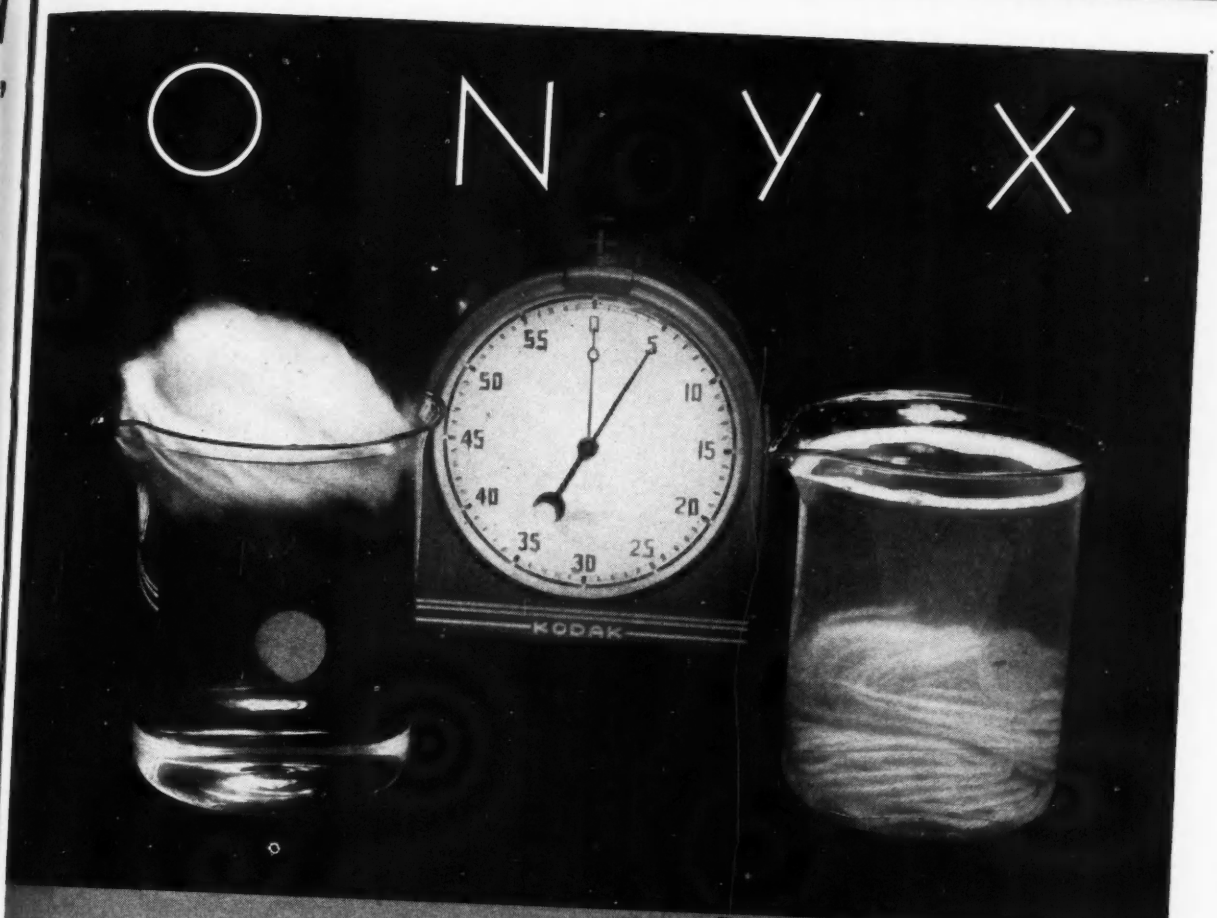

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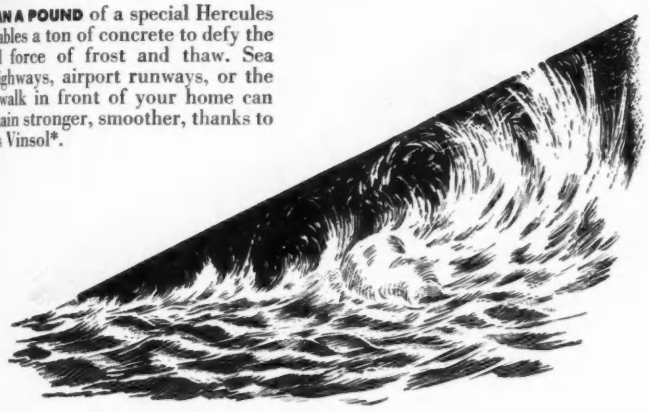

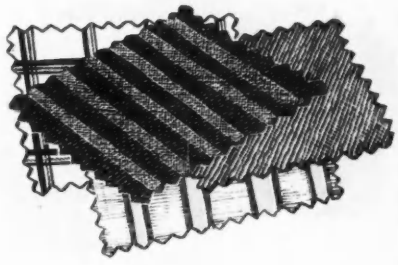

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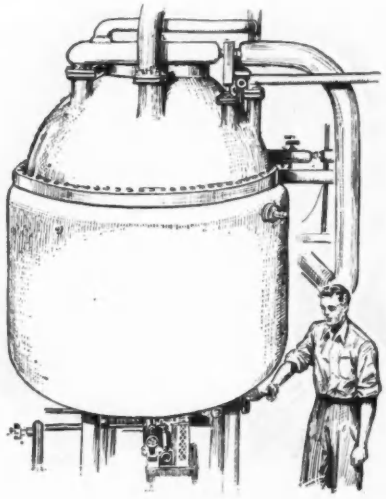

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Eastone Yellow RN Concentrated* is recommended for application printing on cellulose acetate rayon. It is of interest either as a self-shade or as a shading component in the dyeing of dischargeable ground shades. It dyes clear golden yellow shades which have unusual brightness even in pale tints.

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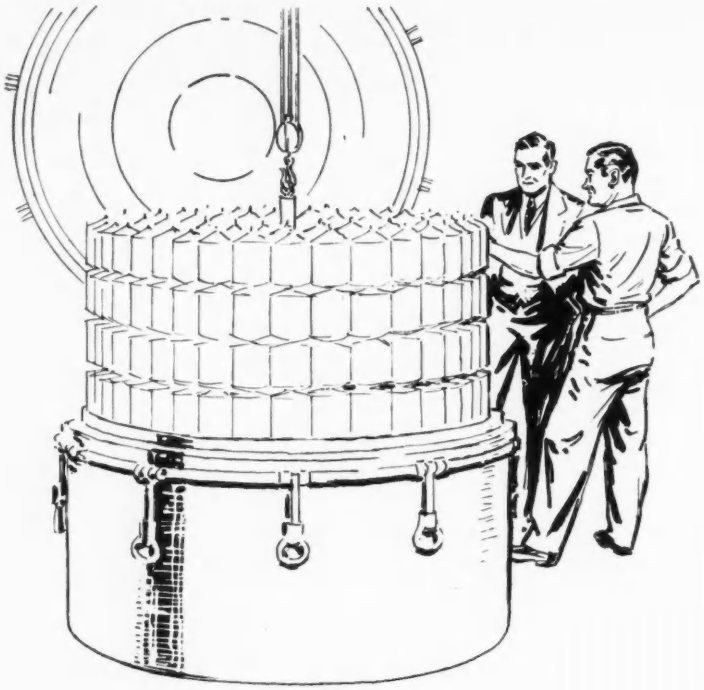

We can't buy new machinery, but we have increased production.

We're using Alkamine K50 . . . It speeds up dye penetration and makes rinsing easier.

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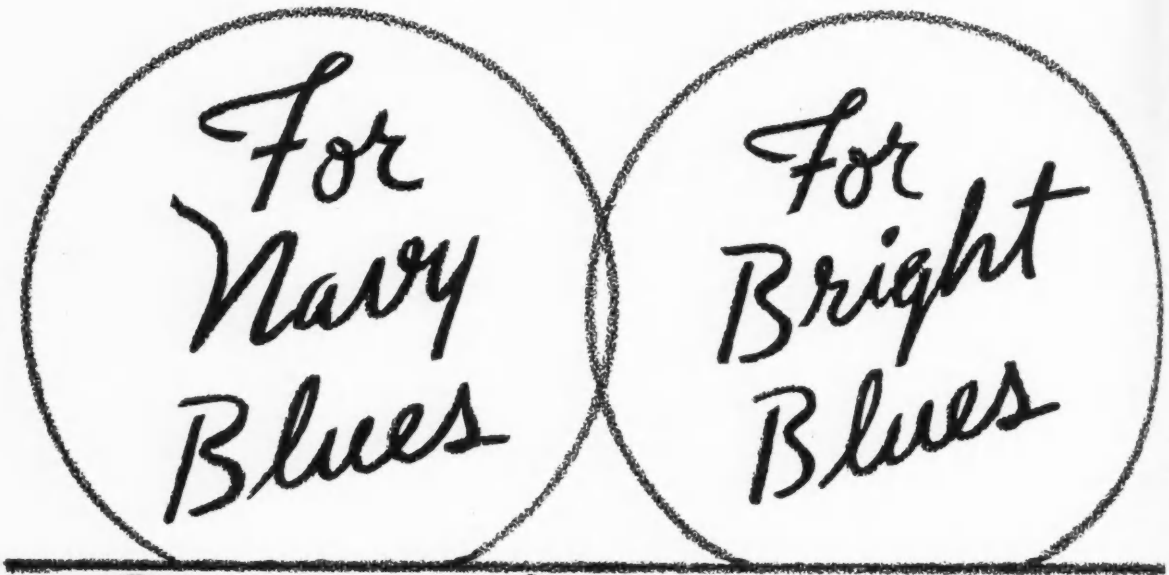

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JUNE 5, 1944

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WILL YOUR COLORS MATCH?

THIS IS THE YEAR the United Nations are asked to show their winning colors.

And that challenge holds just as strongly for the home front as it does for our fighting men.

The textile industry, for instance, has a three-fold aim in getting behind the victory drive. First, it must complete its commitments to the armed services. Second, it must supply more goods for essential civilian consumption this year. Third, war restrictions notwithstanding . . . *quality* must be maintained.

In serving the textile industry, Calco has but one policy. Calco dyes must maintain their reputation as the industry standard.

One measure of the validity of this policy: The good-will we have won in the eyes of textile men over the years. Another measure . . . in serving the armed forces directly, we have already been awarded a *second* star for our Army-Navy "E" pennant for work completed to date on '44's schedule.

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NEOPRENE

and Other Synthetic Rubbers in the Textile Industry*

EMIL H. KRISMANN

E. I. du Pont de Nemours & Co., Inc.

AS members of the textile and dyestuffs industries you will no doubt recall the World War I episode of the German super-submarine, the Deutschland, how she eluded the British navy and landed, once in Baltimore and again in New London, with two cargoes of German dyestuffs that were so badly needed in this country, but I wonder if you know what her return cargo was. From the abundance and wide variety of commodities that were available, she sailed away with only two items aboard in that long hull—nickel and rubber—mostly rubber.

At the mention of rubber there is brought to the minds of most of us the one characteristic in which it stands practically alone, namely, its ability to stretch and to return approximately to its original position. Others may think of it as something with which to erase their mistakes, but to the rubber technologists the term is much more specific and refers to the basic material which is the starting point for the forty thousand or more commercial articles with which our daily lives are associated.

Current and daily information available to all of you through press and radio make it unnecessary for me to stress the importance of this product, but let it suffice to say that rubber, with its newly acquired complements, the synthetic elastomers, is one of the most important, most necessary and most versatile engineering materials known to man. There exists no other structural material that combines its very high extensibility and almost complete elastic recovery, which are the outstanding properties of soft vulcanized rubber and its synthetic counterparts.

Rubber's utility extends from high in the heavens where stratospheric and meteorological balloons help us to forecast the weather, to deep below the surface of the earth as seals in oil wells. Overshoes and raincoats protect us from the elements and help us to keep well and if we are unfortunate enough to be ill, hospital sheeting, hot water bottles, spray bulbs and tubing contribute toward making us well again. In industry the use of rubber has permitted simplification and improvement in design and has increased the serviceability and usefulness of many products.

HISTORY OF RUBBER

Natural rubber has a history that is romantic and colorful. It was perhaps first used by the natives of South and Central America to form crude garments, shoes and play balls. Knowledge of its existence and use was brought to the civilized world by Columbus when he returned from his second trip to the new world in search of gold. He told of a game played on the beaches of the island of Haiti by the native Indians in which they used small black balls that were very lively and bounced on the hard sand. He took back some of these curiosities, never dreaming that this product of a gummy tree juice would later be turned by man into much more gold than King Ferdinand and Queen Isabella ever dreamed of.

Nearly 300 years elapsed before mention was again made of this American gum. About the middle of the eighteenth century a French biological expedition to Brazil brought back samples of the coagulated exudation and named it "Caoutchouc"—"Caou" for wood and "ochu" for tears.

In 1770 some of this material reached England and at that time Priestly, the English chemist, became interested in it because he noticed it was an excellent material for erasing pencil marks and gave it the name "India rubber," the prefix "India" of course denoting that it came from the Indies.

The next fifty years saw many attempts made to utilize this natural gum in the building of various articles such as boots and shoes, and in 1823 we find references to a waterproofed coat which took the name of its inventor, Charles Mackintosh of Glasgow. The name is still used in England to designate what we know as a raincoat.

No real progress was made in the application of rubber to our daily life up to this time, however, because rubber, in its native form, has the disagreeable characteristic of softening and becoming sticky in hot weather and of stiffening and cracking at low temperatures. This fact materially restricted its usefulness and it was not until Charles Goodyear in 1839 demonstrated the radical change in properties which resulted by heating mixtures of rubber and sulfur that new and wider uses were developed.

FAR EASTERN RUBBER INDUSTRY

The original source of crude rubber was the Amazon Valley in South America. The supply was both erratic in quantity and non-uniform in quality because the trees were not cultivated and all gathering of rubber was done haphazardly by natives. In 1876 an English botanist transported a quantity of *Hevea* seeds from Brazil to Kew Botanical Gardens in London where seedlings were started and later transported to Ceylon and Malaya. This was the beginning of the Far Eastern rubber industry. In 1905 the

* Presented at meeting of Northern New England Section, Mar. 17, 1944.

first plantation grown rubber appeared on the market and at the beginning of this war only about one per cent of our total world supply of rubber came from the wild rubber trees of the Amazon.

SYNTHETIC RUBBER

Since our rubber industry depended so completely for its primary raw material upon the milky fluid that exudes from this tropical plant, and since the area in which this plant will grow well is narrowly limited geographically, namely, in a belt that lies within ten degrees above and below the equator, is it not logical that chemists should feel inspired to duplicate nature? You may recall the statement made by Dr. Landis before this group at your last meeting, that even some of the simplest chemical reactions of nature are not yet understood or duplicated. There is probably no natural product of which this is more nearly true than of rubber.

To duplicate nature in the production of rubber is a very difficult problem when one realizes that the rubber tree depends on air and water for raw materials and sunlight for the energy to convert them into the final product. Economically speaking, competition with nature is not sound, so the problem becomes one in which not just duplication, but rather an improvement over nature needs to be found. One who starts out to produce synthetically a replacement for a natural product has but one advantage over nature in that he knows what his objective is and works toward this all the time.

The work on synthetic rubber is not just of recent date. Actually it dates back over a hundred years when chemists began to wonder about the composition of natural products. A great many of the important syntheses were the direct results of attempts to duplicate nature. Wohler in 1828 began the program by his synthesis of urea. You will recall that Perkin was trying to synthesize quinine when he discovered the method of making mauve and thus laid the foundation of the synthetic dye industry. To date quinine still defies the ingenuity and the persistency of the inquiring chemist, but the work has produced other alkaloids and one by one nature grudgingly yields up her secrets and we have as a result those materials with which we are all so familiar now such as indigo, camphor, vitamins and others too numerous to mention.

Early investigations of the chemical structure of natural rubber followed a pattern not unlike that used by workers in other fields, namely by chemical analysis and destructive distillation. This work dates back to Michael Faraday who, through his work, established the fact that the principal constituent of natural rubber was a hydro-carbon having five carbons and eight hydrogens. This was verified later by other workers and in 1860 Greville Williams isolated a low boiling fraction of distillate having the same composition and he gave this material the name isoprene. Bouchardat in 1879 treated this material with hydrochloric acid and obtained a rubber-like product that was elastic and possessed other characteristics of rubber. It is believed that this was the first step of the long road that has brought us to our present synthetic rubber industry.

Prior to 1900 the structure of the rubber molecule was still a relatively dark secret. It was known that the molecular weight was very high, possibly as high as 500,000 and that some isoprene could be obtained from it that could be reconverted back to a rubber-like material, but there were still many voids in the picture.

Finally, just before the turn of the century, Tilden and some of his contemporaries established with positive proof and confirmation the structural formula for isoprene, synthesized it from other materials and thus took another step in the slow march toward a final solution.

EFFECT OF WORLD WAR I

The next era of the synthetic rubber search came just before the first World War when England, Germany and Russia all realized that rubber was becoming a material of vital military importance. The coming of the automobile during this decade had increased the demand for rubber to such an extent that the use jumped from 44,000 tons in 1900 to 94,000 tons in 1910, and it was in this latter year that the price reached an all time high of $3.12 per pound. This high price of rubber and the greater demand for it and the increased activity in the chemical industry in this period were responsible for the efforts that produced the foundations of a moderate synthetic rubber industry in Europe during World War I.

As early as 1912, tires made of synthetic rubber produced in Germany were exhibited in New York by one of the large German chemical companies, but it is well known that the quality of the material used in these tires was exceedingly poor. The incentive for further work was still there, however, and was influenced to a large extent by national and international conditions. The exploitation of the natural rubber plantations was the predominant interest of the English and the Dutch, whereas the Germans continued with their fundamental chemical work and by the time the first world war started they were well on the way to produce a material by the metallic sodium polymerization method that could be used in case of necessity as a replacement for the natural product. The allied blockade forced them to produce during this period a total of approximately 2300 tons of what was known as methyl rubber. This is the first record of the production of synthetic rubber on a commercial scale and was hailed as a very important achievement.

PERIOD FOLLOWING WORLD WAR I

Following World War I there was a slight lull in the synthetic rubber study until the price of crude rubber began to rise and reached a price of $1.21 a pound in 1925. This prompted further research not only in Germany but in Russia and in this country. England continued to remain in the background on this work since they had so much at stake in the plantations which they had developed

earlier in this present century. The Russian and German research work followed a reasonably similar pattern and several methods were developed for the production of butadiene which finally became one of the basic materials of all European synthetic rubber. It is interesting to note that up to this point not a single synthetic product was made from isoprene which is the basic material from which we believe natural rubber to be composed.

Chemists had given up the idea of duplicating nature and set out now to make a product that would be superior. This change in attitude is due partly to the fact that the late 1920's saw a very rapid increase in the use of natural rubber and with this came a multitude of new and sometimes very difficult uses. It became evident that natural rubber was very definitely lacking in a great many characteristics particularly when highly specialized engineering uses appeared.

As a result of this in 1930 commercial production of an extremely oil resistant material called Thiokol was announced. This was a condensation product of sodium polysulfide and an organic dichloride, and was of particular interest because it was radically different in chemical composition and structure from natural rubber, but still had some elastic properties. In the late 1920's the du Pont Company did considerable development work on synthetic rubber and announced in 1931 the commercial production of neoprene. This is a polymerized product of chloroprene which is prepared from the nation's most abundant raw materials—coal, salt, limestone and water. Coal and limestone produce calcium carbide from which acetylene is made. By the action of catalytic agents acetylene is converted to monovinyl acetylene and this upon treatment with hydrogen chloride makes chloroprene. Chloroprene is polymerized by emulsifying in water with soap or a synthetic emulsifying agent. The most interesting feature of this polymerization reaction is that it occurred in a matter of hours, whereas most of the other polymerization methods known at that time required weeks to complete.

The next synthetic elastic materials to appear were those developed in Russia and Germany. Their first products were polymerized with metallic sodium and later new types appeared as copolymers that were made in emulsion form. These were known as the Bunas and are the forerunners of our general purpose product GR-S.

Several other materials with less resilience and other features rather far removed from those of good natural rubber appeared after this, among which were the vinyl chloride polymers, Koroseal and butyral. The last and most recent addition to the group of synthetic elastomers is butyl rubber, a product of Standard Oil Company. It is quite impermeable to gases and has found uses where this characteristic is important. It is conceivable that it may eventually become the logical material for inner tubes.

The physical characteristics of these various synthetic materials cover a wide field and it is believed indicate the approach to a highly specialized and selective period.

Thiokol, for instance, has very remarkable resistance to swelling in all types of oils and solvents but has comparatively low tensile strength, elongation and resilience. It is ideally suited for such products as the linings for hose that carry aromatic fuels. Because Thiokol is made from abundant and easily obtained materials by a very simple process it was the emergency material chosen early in the war for tire recapping, but this plan was abandoned later.

Buna N, or Perbunan, is one of the products developed by the German IG as highly specialized elastomer. Since the war broke out in Europe, production has been undertaken in this country where it is commercially sold under a variety of names. The various brands are not absolutely identical, differing slightly in the ratio of butadiene to vinylcyanide and presumably also in the nature of the emulsifying agents and polymerization catalysts. This product also is widely used in service where extreme resistance to oils and solvents is a basic requirement.

Buna S or GR-S is the name given to the all-purpose synthetic which is being produced in this country, and is a product made by the interpolymerization of butadiene and styrene. The original development work on this material was done in Germany in the early 1930's and it is our belief that this product accounts for more than 90 per cent of the German synthetic rubber production and is likewise the largest volume synthetic elastomer in this country. Its primary use is for synthetic tires, and great strides have been made in the past twelve months on this use. It is now possible to produce passenger car tires that will give almost the same mileage as a pre-war natural rubber tire. This is not wholly true of heavy duty bus and truck tires, but recent results of tests indicate that good progress is being made toward a satisfactory solution of this problem also.

NEOPRENE

Neoprene has been on the market since 1932, was the only real synthetic rubber produced in the United States before the war, and is the largest volume special synthetic rubber being produced here at the present time. Before the war it served in a multitude of uses where natural rubber was unsatisfactory and was used regularly by several hundred manufacturers including all of the important ones. A few months after the war broke out in Europe a shortage of neoprene developed due to the increased demands for it in industrial and military equipment, and since that time a program of allocations in one form or another has governed its distribution and directed most of it into highly specialized uses.

Neoprene is the only synthetic rubber that can be used as a replacement for the natural product for practically the entire range of uses to which rubber is put. It has mechanical properties quite comparable to those of natural rubber and substantially pure gum neoprene products such as rubber bands and inner tubes have practically the same tensile strength, elongation and elasticity as has the corresponding natural rubber product. When loaded with re-

inforcing fillers such as carbon black, as in the preparation of a tire tread, neoprene has abrasion resistance fully equal to that of the best natural rubber treads under all normal service conditions, and is quite superior under conditions of service that involve exposure to sharp, jagged road beds or to extreme heat and sunlight. Heavy duty truck and bus tires show up exceedingly well in the gruelling tests that they are put through regularly.

Compounds made with neoprene have tensile strengths comparable to those of like compositions of natural rubber. The choice of compounding ingredients is the determining factor and tensiles over 4,000 pounds per square inch are not unusual. The diffusion of gases through neoprene is at a much slower rate than through natural rubber which not only makes them useful in the construction of military balloons and in protective clothing, but also in the construction of diaphragms for industrial apparatus.

Neoprene under dynamic loads exhibits a more rapid damping effect than natural rubber compounds. In tests in which two compounds were investigated, one of natural rubber and one of neoprene, the number of oscillations produced by the same shock load was ten in the case of neoprene compared to sixteen for rubber. Neoprene, like rubber, exhibits a drift or deformation under constant load, but the deflection soon reaches a maximum and the permanent distortion upon release of load is quite low. Recovery is practically as complete as for rubber compositions but takes place at a slightly slower rate.

With the exception of Ebonite or hard rubber, all types of rubber compounds swell when exposed to oils. This would not be a serious disadvantage in most commercial applications if it were not for the fact that when rubber is swollen with oils its tensile strength, toughness and abrasion resistance are materially reduced. Neoprene also swells from contact with oils but to a much lesser extent, and what is of greater importance, it retains its strength, toughness and elasticity to a remarkable degree even when swollen. Obviously, the resistance to deterioration of neoprene will vary for different types of oils and solvents with which it comes in contact, but in all cases neoprene is superior to rubber when immersed in or exposed to oils.

Direct sunlight is one of the worst enemies of rubber. The effect known as sunchecking is observable in many products such as garden hose, automobile tire sidewalls, windshield wiper blades, etc. Neoprene products are practically unaffected by sunlight, the only change being a slight stiffening upon prolonged exposure.

This resistance to sunlight can best be illustrated by a study of hydrogen diffusion through balloon fabric over a period of seven months' exposure to direct sunlight. The neoprene film showed an increase in loss rate of 9 per cent as against 1470 per cent for a corresponding rubber film subjected to the same test.

All neoprene compounds display a marked superiority to like compounds of rubber with respect to heat resistance and best results are obtained by the use of a special compounding technique. The fundamental difference in the effect of elevated temperatures on neoprene and rubber is that vulcanized neoprene compositions never undergo reversion such as occur to the best heat-resisting rubber compounds. Neoprene compounds are flame resistant and when properly compounded do not continue to burn after the flame is removed. It has been substituted for rubber in compositions where this property is desired as, for example, in the insulation of electric wire used in mines and on ships.

Neoprene is many times more resistant to oxidation than the best rubber compounds. Its superiority has been demonstrated both by natural ageing tests, which have been conducted over a period of years at normal temperatures in the absence of direct sunlight, and also by the oxygen bomb test which is a common test used by most rubber manufacturers. Neoprene resists chemicals, refrigerants, halogens, etc., better than natural rubber.

A new type of neoprene has been developed that can be plasticized to an exceptionally soft consistency. It may be used to produce resilient caulking compositions or flexible protective coatings which can be applied to a wide variety of surfaces by trowel or brush. Experimental applications have given satisfactory service as linings for certain chemical equipment, coverings for agitators, and coatings on fan blades and on the inside of ducts used in ventilators for corrosive gases.

USES OF SYNTHETIC RUBBERS

It would be rash to state that any one synthetic rubber could be made to serve under all conditions and all types of service. Natural rubber was required to do just that, but we all know that there have been many applications where it was wholly inadequate and others where it was used only because there was nothing better to replace it. Now our rubber manufacturers face their engineering problems with a great deal more confidence because in the last ten or twelve years they have learned to adopt synthetic rubbers to thousands of uses for which they have been found superior to the natural product. Yes, they have gone even further than this, for they are able now to choose from the several types available the one synthetic that is best fitted to do the job. This has given them a background of experience that has been extremely valuable in this emergency, for it is true economy to select that material that will give the best service and the longest life.

With a knowledge of the general properties of these synthetics it requires only a little imagination to realize that products made of them would be extremely useful to the textile manufacturing industry. As would be expected, we find them being used for belting, roll coverings, rub aprons, friction pads and packings. In short, for a multiplicity of the maintenance items which are so important to the efficient operation of textile mills.

An interesting application which illustrates the usefulness of neoprene in this service is that of rub aprons in woolen mills. Owing to the fact that the surface of these aprons

is not attacked by oils or emulsions used prior to carding, the aprons maintain their surface and efficiency and are turning in service records which result in phenomenal reductions in maintenance cost. This same property of maintaining a uniform friction surface when exposed to the deteriorating effect of oil has led to the use of neoprene as a friction pad on thread tensioning devices.

Transmission belting is a constant source of trouble in textile manufacturing and in many plants will be found neoprene belts which are delivering longer life because of their resistance to deterioration by oil and grease.

An interesting possibility in connection with flat transmission belts is the development of static-free compositions. Natural rubber products can be made more or less conductive by means of a special type of compounding. However, neoprene in itself is more conductive than rubber and experimentation has shown that neoprene compounds following the same principles employed in rubber compounding can be made even more conductive. The elimination of static in transmission belts, feeder belts, etc., in the textile industry offers opportunities for investigation.

The use of V-belt drives in the textile industry has been increasing over a period of years. Along with this change has come the neoprene V-belt for use where oil and grease cannot be avoided.

Roll coverings for continuous bleaching equipment for expander rolls, guide rolls and calender rolls are applications where the special properties of synthetics offer opportunities for experimentation, and active work is progressing on the use of them in these products.

The use of neoprene and neoprene-cork combinations for spinning roll coverings is still in the experimental stage but there is reason to believe that neoprene will prove of considerable value in the fabrication of this product.

Feed aprons impregnated with neoprene are an interesting possibility to improve the serviceability of this product.

The weaving of fabrics utilizing synthetic fibres will no doubt introduce many new problems into the textile industry requiring changes in method and equipment. A knowledge of the unique properties of synthetic compositions will be helpful to the engineer charged with the design of new equipment or the economical operation of existing equipment to perform new and different functions.

All of this does not mean that our rubber manufacturers, who are charged with the problem of choosing the correct synthetic rubber and even the correct design for a particular application, face an easy task. The adoption of synthetic rubbers to purposes for which natural rubber has formerly been used, or to purposes where possible redesign of equipment calls for resilient materials, the service of which is too severe for natural rubber, requires not only reformulation of compounds and modification of methods, but also a careful analysis of the engineering problems involved.

For example, there is a tremendous field in the textile industry for the adoption of vibration absorbing mountings for all types of high speed machinery. In most cases the design and composition of such a part involves not only the primary requirement, but it must also meet certain conditions such as oil resistance at the same time. There is no doubt that synthetic rubbers will be used and unquestionably with better results than have ever been obtained in the past from any natural product, but the mechanical characteristics of mounting of all types need careful study in order to otbain optimum results.

The synthetic rubber industry in its early stages of development suffered set-backs and disappointments, but with characteristic perseverance and ingenuity the American chemical engineer, spurred on by the impetus of this national emergency, has in record time overcome most of his problems and has so firmly established this industry in the United States that it will not be many months until all production goals have been attained. Now it can be safely said that there is no question regarding a supply of synthetic rubber adequate for the efficient prosecution of this war to ultimate victory.

DISCUSSION

The Chairman: I should like to ask Mr. Krismann if, at present, practically all of the neoprene is under WPB war priority or if a proportion is still available for use.

Mr. Krismann: The use of neoprene is governed by a directive issued from Washington. The major part of the distribution is governed by allocation.

Mr. Stewart: The synthetics mark badly. Is it possible to make synthetic rubber heels that will not mark off the way the majority of them are doing today?

Mr. Krismann: Practically all black heels, whether synthetic or natural, have some tendency to mark.

Mr. Stewart: But not like the rubber heels they are putting out now.

Mr. Krismann: I don't believe those are synthetic heels. I think most of those are re-claimed heels. There haven't been many heels made of synthetic rubber in this country for civilian use. As soon as the natural rubber was shut off, practically all of the heel and sole manufacturers immediately went over to one hundred per cent re-claimed rubber, and that is a very bad material as far as marking is concerned.

Mr. Stewart: Can't that be corrected?

Mr. Krismann: Not until we get a higher quality heel and that won't be until we have enough synthetic or natural rubber available to make the heels.

Mr. Berg: Is that true of sneakers, also?

Mr. Krismann: I don't know how to answer that question because I don't believe there have been many sneakers made since the rubber restrictions went into effect.

Mr. Berg: I play badminton once a week and the gym floor is always all marked up from the sneakers.

Mr. Krismann: Usually the ability to mark up so will identify it as a re-claimed sole. If you get a good, high-grade sneaker sole made of crude rubber it will not mark.

Undoubtedly you recall the type of sneaker to which I am referring.

Question: Can you tell us the relative effect of alkalis on neoprene versus natural rubber.

Mr. Krismann: It seems to be very definitely less on neoprene. Concentrations involved in the textile industry are not harmful to neoprene.

Question: That includes bleaching?

Mr. Krismann: Yes.

Mr. Shepard: Has neoprene the tendency to stick to metal valve seats the way natural rubber has, particularly bronze?

Mr. Krismann: I can't answer that definitely, but I am quite sure that it does not have that same tendency.

Mr. Shepard: Does it make any difference about the type of metal that the seat is composed of, whether it is tin or bronze?

Mr. Krismann: Bronze would probably be the worst offender. I would like to modify my first statement. I think probably because neoprene does not oxidize as rapidly as natural rubber, the effect of the copper in the bronze seat might not have as much effect on the neoprene as natural rubber. Oxidation makes natural rubber sticky.

Question: Why does neoprene thread break much quicker than natural rubber thread when applied to a hot roll under tension?

Mr. Krisman: It is just one of the characteristics of the material. We don't know yet how to make it as good as natural rubber in that one respect, but we have shown very definitely an improvement in the last twelve months. I think the time will come when we will be able to produce a satisfactory neoprene thread.

Question: With one hundred yards of a certain type of cloth you get ten per cent shrinkage when using neoprene. We are getting thirty-five to fifty per cent shrinkage. You have stated that neoprene has better heat resistance than natural rubber. Would it be the heat that is taking the stretch out of it, or what would it be?

Mr. Krismann: That is difficult to answer without knowing the conditions under which that product was made.

Question: What temperature would be recommended so that it wouldn't hurt the rubber and still dry the yarn?

Mr. Krismann: Temperature isn't the whole story. You have to figure the tension also. The higher the tension, the lower the temperature has to be. There is no way of stating that it has to be 210°F. or 240°F.; it depends upon the tension you have on the fabric.

Question: Is there any other product besides soap used in the polymerization of rubber?

Mr. Krismann: You mean in the emulsification?

Question: Yes, that is right.

Mr. Krismann: Yes; there are synthetic emulsifying agents being used.

Question: Are there any other natural products?

Mr. Krismann: I don't know.

Question: In the neoprene, about forty per cent of the total weight is chlorine, isn't it?

Mr. Krismann: It is a part of the neoprene itself.

Question: Is the neoprene supplied in any form of emulsion comparable to the latex that they were using before the war as a finishing compound which was supposed to give some added resilience. Does the neoprene give the same result, and can it be obtained in that form?

Mr. Krismann: Yes, neoprene is prepared in emulsion form, can be obtained as latex, looks exactly like the natural product, and processes like it.

Question: What is neoprene latex?

Mr. Krismann: It is a soap emulsion.

Question: What is the brittle point of neoprene?

Mr. Krismann: We are furnishing neoprene parts regularly to meet a specification of minus 70°F.

Question: You mentioned vibration dampers a while ago. They are not good on that?

Mr. Krismann: No. You get gradual stiffening as you go down the temperature scale.

Question: The brittle point is not as low as rubber?

Mr. Krismann: I don't know where you would have to go to get to the brittle point. A properly compounded product for cold service will be flexible at very low temperatures.

Question: What about some of the other synthetics?

Mr. Krismann: Buna-S is even better, and better than natural rubber in that respect.

Question: How is the Buna-S standing up in squeeze rolls?

Mr. Krismann: I should imagine ultimately they will be able to make pretty good squeeze rolls with Buna-S compounds.

Question: What is the freeze resistance of neoprene thread?

Mr. Krismann: Once you get down below zero, you begin to get pretty loggy thread.

Discussion Session of the Inter-Society Color Council, March 1, 1944, on SMALL COLOR DIFFERENCES

This meeting co-sponsored by the American Association of Textile Chemists and Colorists and the Federation of Paint and Varnish Production Clubs

(Continued from May 22, 1944, issue)

Chairman Judd: Thank you, Mr. Stearns, for a very concise and able summary of the importance of small color differences in textiles.

Miss Dorothy Nickerson of the War Food Administration has prepared a Summary of Available Information on Small Color-Difference Formulas. Miss Nickerson.

Miss Nickerson's paper follows:

SUMMARY OF AVAILABLE INFORMATION ON SMALL COLOR DIFFERENCE FORMULAS

DOROTHY NICKERSON[1]

ONCE color can be accurately specified, the next practical requirement is that color tolerance and color fastness be accurately specified. Satisfying one need does not necessarily provide an answer to the other.

Perhaps one thing that will be of help to us this morning is (1) to examine the various general formulas that are available for specifying small color differences; (2) to discuss the concept upon which each is based; (3) to see how much work is involved in making the computations for each; and (4) to see how the results compare with each other and with visual estimates.

One principle must be recognized before any general expression for small color difference can be satisfactorily developed. A general expression must involve judgments of "equality of color difference." Thus many methods that may serve for individual cases, or for restricted groups of colors, will not serve as a general basis for expressing color difference.

There are several methods that are being used and will be described later today by representatives of member bodies who employ them in their work. One example is a specification that states:

Y shall not be less than .... nor more than ....
x shall not be less than .... nor more than ....
y shall not be less than .... nor more than ....

Such a specification is one of the first methods that one might think of using if measurements are in terms of I.C.I. data; but though their use may be a first step toward setting tolerances it is at best only a stop-gap. The use of circles or ellipses drawn about certain I.C.I. points is a next step. Or, as has been done by Mr. Constantin Monego in using the Snow instrument at Forstmann Woolen Company, a method of selecting differences at selected wave lengths for certain groups of dyestuffs may work very well when applied by a research worker to a particular group of materials. Dr. Wallace R. Brode has used a similar method in his work on a series of dyes. Or the MacAdam ellipses may be employed in setting tolerances for specific colors or groups of colors. None of these methods, however, is generally applicable to all colors.

To be generally applicable a formula for small color differences must be based on some form of color space that bears at least a reasonable approximation to psychologically equally stepped scales—in other words to some basis of providing uniform chromaticity and lightness scales.

To provide a complete tolerance specification such factors as transparency, glossiness, and luster should be taken into consideration, as well as the purpose of the tolerance, which may often control its relative size. It is enough at present, however, to limit ourselves to the attributes of color perception, hue, lightness, and saturation and those characteristics of light that are their correlates, dominant wave length, luminous reflectance, and purity. (For definition of these terms see "The Concept of Color," fig. 3, from the O.S.A. Colorimetry Committee Report, J. Opt. Soc. Am., p. 552, October 1943.)

Several formulas for general use have been developed, and it is to these that I call special attention this morning. For the purpose of this discussion six such formulas have been examined.

I, developed as an Index of Fading by Nickerson, reported in 1936 (*1*);[2]

I′, this Nickerson Index adjusted to agree with Euclidean space, as suggested by Balinkin (*2*);

ΔE_J, the Judd index (NBS unit, or as used by Balinkin, the "judd" unit) (*3*);

ΔE_{H-S}, the Hunter-Scofield index, a modified form of Judd's ΔE (*4*);

$\Delta E_{A'}$, a formula based on Adams' "chromatic value" (*5*); and

$\Delta E_{A''}$, a formula based on Adams' "chromatic valence" (*6*).

In table 1 you will find each of these formulas listed.

The first two are based on the concept that equality of color differences may be represented by reference to a 3-dimensional psychological color solid, with scales equivalent to Munsell hue, value, and chroma. The relations of hue, value, and chroma differ for the two formulas.

I, which is the preferred form of the first of these formulas to be published, is based on the assumption that for illuminant C and usual conditions of observing samples similar to those in the Munsell Book of Color, the scales of hue, value, and chroma approximate the relation: 1 value step = 2 chroma steps = 3 hue steps at chroma /5. The formula assumes that for small color differences the hue, value, and chroma differences may be added to provide a satisfactory approximation of the total color difference. The formula is given in numbers that make the unit value for the Index equal to 1/3rd of a Munsell chroma step.

Because this formula does not have the property of a metric in Euclidean space, Balinkin (*2*) suggested that it

[1] Office of Distribution, War Food Administration, United States Department of Agriculture, Washington, D. C.

[2] Italic numbers in parenthesis refer to Literature Cited.

TABLE 1
Six formulas for general use in specifying small color differences for average daylight conditions.

Author	*Symbol and Formula*	*Type or color space on which formula is based*
Nickerson	$I = \frac{C}{5}(2\Delta H) + 6\Delta V + 3\Delta C$	Munsell 3-dimensional concept of hue, value, and chroma (H—V/C)
Nickerson-Balinkin	$I' = [(\frac{C}{5}2\Delta H)^2 + (6\Delta V)^2 + (20/\pi\Delta C)^2]^{1/2}$	
Judd	$\Delta E_J = f_g \left([7Y^{1/4}\ [(\Delta\alpha)^2 + (\Delta\beta)^2]^{1/2}\ .10^2]^2 + [k\Delta(Y^{1/2})]^2 \right)^{1/2}$ when $\alpha = \frac{2.4266x - 1.3631y - 0.3214}{1.0000x + 2.2633y + 1.1054}$ $\beta = \frac{0.5710x + 1.2447y - 0.5708}{1.0000x + 2.2633y + 1.1054}$ $f_g = 1.0$ for matt surfaces $k = 100$	3-dimensional concept combining Judd UCS diagram with a scale of lightness, ($L = Y^{1/2}$).
Judd-Hunter-Scofield	$\Delta E_{H-S} = \sqrt{(L_1 - L_0)^2 + (a_1 - a_0)^2 + (b_1 - b_0)^2}$ when $L = 100\sqrt{Y}$ $a = 7L\alpha$ $b = 7L\beta$ and α and β are the same as in the Judd formula	
Adams "Chromatic Value"	$\Delta E_{A'} = [(k\Delta V)^2 + [\Delta(V_x - V_Y]^2 + [.04\Delta(V_z - V_Y)]^2]^{1/2}$ when $k = 0.23$	3-dimensional concept in which the coordinates are V_Y, $(V_x - V_Y)$ and $(V_z - V_Y)$, V being Munsell value.
Adams "Chromatic Valence"	$\Delta E_{A''} = [(k\Delta V)^2 + \Delta(W_x)^2 + (0.4\Delta W_z)^2]^{1/2}$ when $W_x = [(X_c/Y - 1)]V$ $W_z = [(Z_c/Y - 1)]V$ $k = 0.5$	3-dimensional concept defined by V_Y, $[(X_c/Y - 1]V$, and $[Z_c/Y - 1]V$; V again being Munsell value, and X,Y,Z the I.C.I tristimulus values for "C" illuminant.

be modified to give it this property. This modification results in relations that are approximately as follows: 1 Value step = 1 Chroma step = 3 Hue steps at Chroma /5. The size of the unit color difference now becomes $\pi/20$ chroma steps, or about 1/6th of a Munsell chroma step.

As may be seen from an examination of these two formulas, the first one is extremely simple to apply; if one has the Munsell re-notations this formula often may be applied mentally. And the second one, though it is the square root of the sum of the differences squared, is still reasonably simple and takes only a few seconds to apply. If the color specifications of sample and standard are in I.C.I. terms, and not in Munsell re-notation, they may be converted from table II and figs. 1-9 of the Newhall subcommittee report in the July 1943 Journal of the Optical Society of America with no more trouble than is involved in obtaining dominant wave length and purity from I.C.I. specifications by reference to the Handbook of Colorimetry. For careful work it is suggested that large-scale charts be used in place of those in the Journal of the Optical Society. This should be easy to do, since large large-scale charts of this sort have been made available to those in the color field who have asked for them.

Judd's ΔE and the Hunter-Scofield ΔE are based on the concept that equality of color differences may be derived from chromaticity and apparent reflectance of samples when referred to a 3-dimensional figure in which the chromaticity is expressed in terms of Judd's "Maxwell triangle yielding uniform chromaticity scales." In this 3-dimensional figure, Judd assumed distance to be a close measure of the perceptibility of the corresponding color difference, and because the square root of apparent reflectance (the old Munsell scale) is known to correlate well under usual observing conditions with observer's estimates of lightness, the lightness differences are made to equal to $k(\Delta Y^{1/2})$ in his formula. Since the ratio of chromaticness differences to chromaticity differences vary with the lightness of the sample, Judd included a term that assumes the ratio to be proportional to $Y^{1/4}$ and therefore the chromaticness difference is taken equal to $kY^{1/4}\Delta S$ where ΔS is expressed in Judd UCS units of r,g,b. A term f_g is included to account for the masking of perceived color difference by specularly reflected light. For mat surfaces f_g is unity, for glossy surfaces it is assumed to equal $Y/Y + k_g$ where k_g is a constant referring to the conditions under which the samples are visually observed.

The particular form of the formula is given because of convenience of graphic evaluation. Twice in computing ΔE it is necessary to find the square root of the sum of two squares and Hunter suggests that these operations may be done graphically with sufficient precision by use of a pair of dividers and a piece of cross section paper to get the length of the hypotenuse of the right triangle whose other two sides are known. If one has much work to do, and chooses to use the Judd formula, such short cuts should be followed. If one uses an instrument in which the results may be directly expressed or easily converted to terms approximating the Judd UCS scale, as for the Hunter Reflectometer, then the Judd formula may be applied with reasonable directness. If, however, the data are in I.C.I. terms then α and β must be obtained as a preliminary part of either the Judd or Hunter-Scofield formulas.

The Hunter-Scofield modification of the Judd formula was made in order to simplify it and make it easier to use in practical work (*7*). In the paint industry considerable use is made of the Hunter Reflectometer (much less of the spectrophotometer as compared with the textile industry), and from results on the Hunter instrument α and β may be obtained by the relatively simple formulas:

$$\alpha = \frac{A - G}{A + 2G + B}, \text{ and } \beta = \frac{0.4(G - B)}{A + 2G + B}$$

when A, G, and B designate amber, green, and blue filters on the Hunter instrument.

The Adams formulas are based on two types of color space developed by Adams, the first relating to formulas converting I.C.I. tristimulus values X, Y, Z into "chromatic value" space, the other into "chromatic valence" space. In each the illuminant point is plotted at the O point; therefore values of X, Y, Z must be equalized, instead of being expressed as is usual at present in terms of equal energy at the center of the diagram.

In "chromatic value" space the coordinates are V_y, $(X_x - V_y)$, $(V_z - V_y)$, V being the Munsell value function. The resulting space has the same vertical dimensions as Munsell space and the chromaticness of the Adams space is related to Munsell space as shown in figure 1. The value relation to chromaticness is expressed by k, which we have used equal to 0.23. As used in a recent study made by Nickerson and Stultz (*8*) the formula departs somewhat from the form published by Balinkin.

The "chromatic valence" space of Adams was developed to make radial distances, when plotted with a scale factor of 2½, more nearly equal to changes in Munsell chroma than they are in "chromatic value" space. "Chromatic valence" space is defined by V_y, $[(X_c/Y) - 1]V$, and $[(Z_c/Y) - 1]V$. In this case, the value relationship to chromaticness is expressed by $k = 0.5$.

Because the concept of Adams space is new to most of you it may seem complicated, but actually the development of color difference specifications by use of either of Adams' formula, particularly the one based on "chromatic value,"

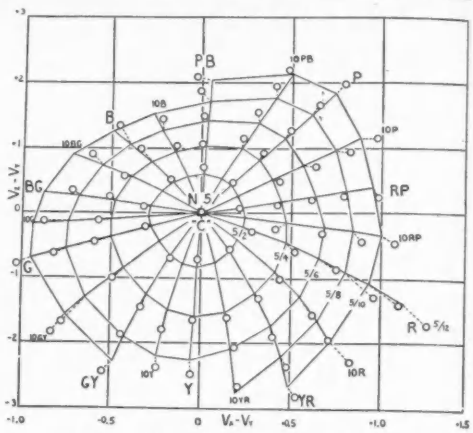

Figure 1. Adams "Chromatic Value" of Munsell Colors at Value Level 5.

is simpler than the use of the Judd formula or the Hunter-Scofield formula unless for the Hunter-Scofield formula you already have α and β. The Adams formulas work directly from I.C.I. X, Y, Z data, and in the case of "chromatic value" can be solved easily with the use of table II in the Newhall report (July 1943 J.O.S.A.) and two tables similar to it adjusted for $X = 1.0$ and $Z = 1.0$. It is not even necessary to obtain (x, y)-ratios.

Up to this point we have considered three out of the four points raised in the opening of the discussion: (1) we have examined the various general formulas; (2) we have discussed the concept upon which each is based; and (3) we have discussed the relative amount of work involved in making the computations for each. The fourth point now remains for consideration—to see how results based on each formula compare with each other and with visual estimates.

For this purpose we should have available studies based on a good statistical sampling of the color universe. Lacking this, we take the best sample we have, nine series of color samples in greens and drab browns that Keith F. Stultz and I have been studying recently. (Any of you interested can hear a report of this study by attending Saturday's session of the Optical Society meeting in this hotel.)

Prior to our work, Dr. Balinkin studied and reported to this group on 5 green tile observed in pairs by 60 observers. Each tile was carefully measured, and 4 of the above described small difference formulas applied to the nine pair of dfferences, based on measurements made not only on the spectrophotometer but on other instruments as well, the Hunter Reflectometer, and the Bausch & Lomb disk colorimeter. He found the formula that most closely approximated the relative size of difference as averaged from results of 60 visual observers to be the I formula based on the Munsell concept, and because he thought the relation might be improved if the I formula were put into terms of Euclidean space, he suggested I′, and found that for his samples it did improve the results. Results from

the several formulas he used were all grouped fairly close together; therefore, because he was using the Hunter Reflectometer (at that time it would have been difficult to obtain accurate Munsell notations; now, however, they may be obtained easily through the O.S.A. subcommittee report which provides smoothed conversion charts), he followed the Judd method for expressing his color differences, calling them so many "judds."

In the series that Mr. Stultz and I studied there were 187 chromatic samples, divided into 9 sets of colors. For each of these 9 sets we had a standard. All were carefully measured on the spectrophotometer and calculations made for the several small difference formulas. Each sample was also visually compared with its standard by a number of observers (14 to date), with the difference result reported as "passing" for a match or "failing" a match on a scale of 6, that is:

No. 1 Pass—very good match
No. 2 Pass—satisfactory match
No. 3 Pass—borderline
No. 4 Fail—borderline
No. 5 Fail—poor
No. 6 Fail—very poor

As a measure of the relative success of each formula in providing a placement for each sample that would compare with the average placement of samples by the first 10 of our observers, we correlated the tolerance indices obtained by the 6 formulas against the average visual placement by 10 observers. The results are shown in table 2.

TABLE 2

Correlation (R^2) of tolerance indices by 6 formulas for specifying small color difference, against average visual placement by 10 observers.

	By Formula					
Color Series No.	I	I′	ΔE_J	ΔE_{H-S}	$\Delta E_{A'}$	$\Delta E_{A''}$
	R^2	R^2	R^2	R^2	R^2	R^2
1	0.49	0.42	0.43	0.40	0.37	0.39
2	.42	.53	.55	.52	.53	.62
3	.58	.51	.67	.53	.65	.55
4	.78	.79	.77	.81	.71	.57
5	.48	.33	.40	.58	.50	.57
6	.86	.75	.48	.87	.75	.64
7	.90	.90	.92	.87	.86	.84
8	.35	.44	.0009	.20	.21	.14
9	.53	.71	.58	.32	.21	.36
Average	0.60	0.60	0.53	0.53	0.54	0.52

As may be seen, on the whole there is less difference due to formula than to the particular series of samples under consideration. When the correlation for any series was high by one formula it was usually high by the others, and when low by one, it was usually low by all.

On some groups, one formula may give better results; on another group it may be another formula that gives results nearest to visual estimates. On the whole the Munsell formulas seem best at an average R^2 of 0.60, the other formulas coming slightly below at 0.53 and 0.54. If it were not for the complete lack of correlation of the Judd formula to visual estimates on color group No. 8, the Judd formula would average 0.60 which is also the average of the Munsell formulas.

Correlation of 10 individual observers' results against their own average results varies from $R^2 = 0.65$ to $R^2 = 0.81$, with an average of 0.70. Since these correlations are based on a self-average, it is to be expected that the figures will be high in comparison with the results based on formulas, particularly when it is remembered that errors in sampling, measurement, and calculation, and in the assumption of an illuminant that may differ significantly from the one used in observation, are all included in the correlation figures based on formulas.

It is not the purpose of this discussion to go into the matter of variations among individual observers, but it can be said that there is so much variation between individuals that if comparative results are to be made by one laboratory with another, the use of whichever formula happens to be most convenient would give more consistent results (when based on accurately sampled, and accurately calculated measurements) than observations by individual observers. It should be pointed out, however, that the color differences we are discussing are so small that original instrument measurements must be made accurately on adequate and representative samples, with accurate calculations that include instrument calibrations, if comparisons are to be made between laboratories. For example, the present report would be more complete if we had results measured and calculated for another spectrophotometer, for two Hunter instruments, and for two disk colorimeters. On the present study the correlations would have been higher if measurements had in all cases truly represented the color differences that were visually examined. This is quite noticeable for several samples that rate high by all formulas as compared with low ratings for the same samples when visually examined. Sample unevenness is not always treated alike by instrument and eye.

SUMMARY

We have examined six general formulas for specifying small color differences, two based on the Munsell concept of hue, value, and chroma relations; two based on the Judd UCS diagram and a lightness scale that equals $Y^{1/2}$; two based on Adams color space concept of "chromatic value" and "chromatic valence." Application of the first Munsell formula requires the least work, the Adams "chromatic value" next less, then follow the second Munsell formula, the Adams "chromatic valence" formula, the Hunter-Scofield formula, and finally the Judd formula. There is an unexplained breakdown in the Judd formula which for one set of data (Series No. 8, table 2) gave no correlation against visual observations; by the Adams and Hunter-Scofield formulas there was some correlation ($R^2 = 0.14 - 0.20$); by the Munsell formulas there was significant

correlation compared with visual observations ($R^2 = 0.35 - 0.45$).

Results of formula differences as correlated against an average of visual observations rate the results by the Munsell formulas slightly higher than by the other formulas. If there were no breakdown in the Judd formula for color series No. 8 (table 2) results by his formula would equal the average by the Munsell formulas. However, the averages of results obtained by the several formulas do not differ greatly; therefore it seems reasonable to suggest that the formula most applicable to the instrument or data be used. The simple form of the Munsell formula is suggested for use until such time as a new Munsell formula can be developed on the basis of adequate experimental data that will provide enough improvement to warrant a change in the constants or present form. For those who do not wish to use a Munsell formula, it is suggested that before they go to the considerable work involved in using the Judd or Hunter-Scofield formulas they seriously try out one or another of the Adams formulas, for they provide as good a UCS color space as the Judd UCS space, and if data are already in I.C.I. (X, Y, Z)-terms, the formulas require less work to apply and give equally good results.

Accuracy of results by use of any of the above formulas depends upon the relative accuracy of the original color measurements to which they are applied. It should not be expected that the order of size of color differences as calculated by any one of these formulas will agree with an observer's order any more than that the order of two observers will agree. The advantage with the formula is that the size of difference applied to a given pair of color measurements will always calculate to the same answer.

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* * *

Dr. Judd: Thank you, Miss Nickerson.

I think I ought to say something about the performance of the Judd formula on series No. 8. I asked right away —what have all these other formulas got that my formula hasn't got? And I went over the data which Miss Nickerson kindly supplied to me and I found that the Scofield-Hunter variation, which has been proposed by the way for a particular group of colors which we call camouflage colors, has got something quite different, the importance of which I didn't realize before, and that is the way the variables A and B are defined. If you will notice in the formula A is equal to 7 times the lightness times alpha, and B is equal to seven times the lightness times beta. We have the achromatic axis from black to white. Lines of constant chromaticity, that is, constant alpha and beta, radiate from the black point more or less along straight lines; lines of A and B constant, correspond more nearly to lines which remain parallel to the achromatic axis in the Munsell color solid. (Illustrating with blackboard diagram.) And I am quite convinced through my analysis of Miss Nickerson's data that the reason the Judd formula gives poor correlation with this series No. 8 is that it under evaluates differences involving constant chromaticity; whereas if you compute such differences in terms of Munsell value, hue, and chroma, a considerable chroma difference is found. If this chroma difference is given considerable weight, you get better correlation with the observers. Here we have for the first time a group of samples in which it looks as though observers in judging lightness differences for constant hue and chroma thought that the sample had not changed very much. But if you consider that directions of constant chromaticity are the directions which you will not pay much attention to, you get a result which does not agree with many of the observers. And there is another fact to mention that the observers, themselves, on this series No. 8 showed an unusually wide variation which suggested perhaps some of them had their color thoughts going along hue and chroma constancy lines and others had their thoughts going along constant chromaticity lines. I would like to do a little more work with individual observers to see if that is the real view of the thing. We have been emphasizing the importance of Munsell variables for a long time, but I believe this is the first indication that observers' estimates of color differences really depend upon the way they organize the color solid. If it is true that observers in general do think and act along Munsell lines, the Judd formula ought to be superseded.

Miss Nickerson: It should be pointed out, too, that many of these observers were not particularly acquainted with the Munsell concepts. They were using them unconsciously if they did use them.

Chairman Judd: I was one of the observers. I was going to see how mine came out. (Laughter.)

The next paper is Application of a Small Color Difference Formula in Paint Problems by Francis Scofield, of the National Paint, Varnish & Lacquer Association, and S. E. Beck, of the Paint and Automotive Chemical Laboratory, Aberdeen Proving Grounds. I believe that Mr. Scofield was to give that paper. Mr. Scofield.

APPLICATION OF A SMALL COLOR DIFFERENCE FORMULA IN PAINT PROBLEMS

FRANCIS SCOFIELD

for the National Paint, Varnish & Lacquer Assn.

I AM sorry to say that I received a wire in Cincinnati that Mr. Beck is unable to attend on account of illness, I understand. So I am faced with the task, at least in some measure, of interpreting to you, or trying to, some data which I didn't have anything to do with obtaining. However, the principal purpose of my remarks is to show how this one particular Scofield-Hunter-Judd formula (more Hunter I think than anybody else) has been applied to some problems. These are not quite the problems of the type that Miss Nickerson dealt with. Every one of them deals with fading, that is, a comparison between an original and a final color of the same sample. There is an important place in the paint industry for such measurements. For many purposes if you get reasonable correlation with an observer's views, an observer's opinion, it is satisfactory as long as there is close agreement between different laboratories as to the property that is being measured.

I don't believe there is any particular point in trying to present to you the actual numerical data. There are published or available in other forms three fairly extensive studies of fading to which I can refer you. The first one—the first time that any large number of numbers obtained by this work was published—was in a paper given by Harry Feinberg at this Cincinnati symposium of the Federation of Paint and Varnish Production Clubs last spring, and published in the May issue of the Official Digest of the Federation. In this twenty-three olive drab paints were prepared which varied only in one pigment used in them, and these were exposed to a number of accelerated and natural weathering conditions for various periods of time. The results were calculated. No careful study was made of the correlation with individual observations, but overall examination indicated that it was reasonably adequate. The important thing for this purpose was the internal consistency of the data. In every case a panel which had been exposed two months gave a larger change than one which had been exposed one month. And a panel which was bad in Florida was also bad in exposures in Maryland. It gave a high number. As a matter of fact, there was almost a linear relationship. We had three months' exposure in Florida and measured them at the end of one, two and three months and there was almost linear relationship between the age and the average color difference. This indicated that the method at least had some merit. That paper is going to be elaborated.

The second set of data was examination by the laboratory of twenty-six or twenty-five paints, blue, lusterless blue, enamels, which were again pigmented in various forms and exposed to accelerated weathering. Here the calculated color difference is compared with a visual appraisal and the agreement is very good. That is, color difference units of less than six agree with visual appraisal of slight fading, from six to seven moderate, and in excess of seven in general the terminology varies, sometimes it is extensive, sometimes it is bad; there are also other types of color change coming in there, such as darkening.

It is still a debatable question how a paint technologist, for example, will rate abnormal changes on something of this sort. We expose a blue paint and we expect it to undergo a certain amount of change. If it undergoes a change in a different direction from that that we expect, there is a definite tendency to rate it poorer even though th actual magnitude of the change has not been large since none of us likes abnormal behavior. We tend to be unduly critical of that. Uneven fading, streaking, things of that sort are invariably given worse rating than normal smooth change in the expected direction. This second set of experiments—I have a galley from the fifth volume of Dr. Mattiello's book—is in a chapter by Mr. Beck on paint testing in which this is used to illustrate the color changes. I understand that book will be available next week.

A third investigation consisted of eight panels of entirely different types in pairs. Two of them were the standard lusterless olive drab that you all see on Army vehicles around the place. Two of them were a semi-gloss. And two of them were a gloss. One was a lusterless blue drab and another was an olive drab of another type in ammunition coating lacquer, but presumably the same initial color. These results were compared by, I believe, sixteen observers. They were furnished with a panel of the initial color and the faded color and they were asked to arrange them in the order of increasing fading. There is, as might be expected by Dr. Judd, a very serious breakdown of the formula in that investigation because of the fact that gloss changes as well as color changes are involved. And one of the things which I did in the interests of simplification to Dr. Judd's formula was to leave out the factor involving the gloss. Also, again, I am afraid you get into wide individual variations there depending on how much relative weight is given to loss of gloss as compared to loss of color. That is, some people may expect a gloss paint to lose gloss on exposure and disregard that; other people do not disregard it. But there is no question but what one of the serious handicaps to the use of this formulation is that it is

not applicable 100% to any type of paint; that is, you can't put a single numerical limit on and say that is the amount of color change we are going to allow in any paint on fading because gloss and semi-gloss and luster also apparently have different visual criteria of the amount of permissible fading. It is confused by the fact that the visual criteria are not too well established.

There is a fourth set of data of much the same type as the first one I mentioned, a large number of panels which had been exposed to a number of different weather conditions, New Jersey and Florida, also several accelerated tests, and read at different times. That set of data has not been published: I think it is going to be given in part by D. H. Parker of DuPont at a spring meeting of the Federation in Cincinnati, although how much of the numerical data he will give I do not know.

One thing that has been brought out by a lot of this stuff is that for many of these purposes where color change, fading in an accepted direction, is to be the important thing, that lightness change is adequate to measure it. This is naturally not the only change that takes place, but there is frequently a very close correlation between lightness change and the total calculated color change.

The principal purpose of these remarks is to bring to your attention the fact that one of these formulas has been used on several extensive series of data by different operators and with this one exception where paints of widely varying gloss were included in the investigation has performed acceptably and, especially, and I think it is an important test, in the internal consistency of the data.

I would like to close by emphasizing—and some of these data bring it out very importantly—Miss Nickerson's remarks about the importance of precision of measurement. I am sorry to say that that is one thing we have practically no evidence on. The only sets of panels which I have seen which have been examined by more than one laboratory, more than one instrument, the agreement between the laboratories was certainly of no higher order than the agreement between two observers on visual examination would have been. Most of our instruments have under careful operation by competent operators a high degree of self precision, internal reproducibility, and I am afraid that that has deceived us on occasion into false estimates of their accuracy. Maybe I am at the moment, having come back from the A.S.T.M. meeting where I was harassed by some of these troubles, unduly pessimistic about the agreement to be expected between instruments. But I am afraid that that is one of the things that is going to have to be investigated with a great deal of care in the future because there is no use developing formulas of high precision unless you have the instrumental measurements of equivalent precision.

* * * *

Chairman Judd: Thank you, Mr. Scofield.

Mr. Scofield has raised a very important point when he remarks that if the sample to be judged differs from the standard in gloss as well as in lightness and chromaticity that has to be taken into account and no doubt there will be some remarks made about that when we get to the general discussion.

Mr. Scofield: Excuse me, Mr. Chairman, I forgot to say one thing. I have several sets of those panels in case anyone is interested and would like to examine them of that last series of the gloss differences there as well as the color difference and after the meeting if anybody is interested why we can discuss them.

Chairman Judd: Thank you. I am sure many of us will want to look at them. I ought to point out, however, that the Judd formula which has a gloss determination in it was merely intended to take account of judgments of the equally glossy sample and standard at the high gloss range, at the semi-gloss and at the mat range, but it does not take account of sample and standard differing in gloss. The formula that you would think of using in that case would be to include under the square root sign not only terms representing difference in lightness and chromaticity but also a term for the difference in gloss. In order to account for these results that Mr. Scofield has mentioned you would have to have a four dimensional concept of color instead of three dimensional.

With these papers preliminary to our discussion of evaluation of small color difference, we proceed now to an expression of the views of three of our member bodies with respect to small color differences, those who are dealing with them in practice most intimately—the American Association of Textile Chemists and Colorists, the American Ceramic Society and the Federation of Paints and Varnish Production Clubs. The first and last of those names have, as you can see in the title, co-sponsored this discussion session with the Inter-Society Color Council and I am sure we owe a great deal of the effectiveness of this meeting to that co-sponsorship.

We will hear first from Dr. Carl Z. Draves of the General Dyestuff Corporation who is Chairman of the delegation to the Inter-Society Color Council from the American Association of Textile Chemists and Colorists. He will be assisted by certain other members of the AATCC; Mr. Monego of the Forstmann Woolen Company, Mr. Simon of Sidney Blumenthal & Company, and perhaps others of the Society also. Dr. Draves.

Dr. Draves: The delegation of the American Association of Textile Chemists and Colorists to the Inter-Society Color Council selected Mr. Stearns to give our principal paper, and that you have already heard. Mr. Monego and Mr. Simon will present brief additional discussions. It is not my purpose to do more than call attention to the importance of the problem and to indicate the attitude that the American Association of Textile Chemists and Colorists has taken on the matter.

The A.A.T.C.C. was founded in 1921 and early came

upon these problems of measuring small color differences visually. It wasn't until later that the application of instruments to the problem became possible. The ability to express differences numerically represents an advance, and we would like to be able to do this so that we can determine without human bias when a sample passes or doesn't pass. It should be pointed out, however, that in the application of a numerical method the instruments and the general methods of application must be simplified so that the practical man who helps make up the membership of the American Association of Textile Chemists and Colorists can use them. Our membership is constituted mostly of men who are practical dyers and textile chemists in mills that do not have expensive instruments, and in which the men are not used to making complicated calculations. We appreciate the problems, however, and hope that through the Inter-Society Color Council and in cooperation with it, methods and instruments will be developed which can be standardized and so simplified that they can be of practical use to the textile trade. It is really the purpose of this meeting to help along such a general development.

I now call upon Constantin Monego to describe to you how at the Forstmann Woolen Company they use the Snow Duplex Spectrophotometer to measure small color differences. They have at Forstmann one of two instruments with which some of you are familiar. I believe the other instrument is now at the Navy Yard laboratories in Philadelphia.

Miss Nickerson: Mr. Chairman, Mr. Monego unfortunately has been called out of town and has sent this paper through Captain Backer which he has asked me to read. Mr. Monego's paper follows.

* * *

USE OF THE DUPLEX SPECTROPHOTOMETER IN EVALUATING FASTNESS TESTS

CONSTANTIN MONEGO
Forstmann Woolen Company

WHEN evaluating a fastness test the Textile chemist has to answer two questions:

1. Is the sample as fast as the standard?

2. Does it measure up to, or is it better than previous lots of this material?

The Duplex Spectrophotometer is used at the Forstmann Plant to supply the answer to these questions The Snow Duplex Spectrophotometer combines well known optical and television principles to give a rapid and continuous measure of color. It has two analyzing positions, one for the standard and the other for the sample. The curves of the two colors are simultaneously projected on a cathode ray tube in full view of the operator. The machine is easy to operate, the left analyzing position, reserved for the standard, can be controlled electrically in steps of 0.01%. When a white standard is used, the complete curve of the colored sample can be plotted, or a reading may be taken at any portion of the color curve.*

The evaluation of a fastness test with the Spectrophotometer is a comparison of two color curves, one of the untreated portion of the material and the other of the treated part. Thus the degree of separation of the two curves is a good measure of the effect the treatment has on the color. The full color curve is not necessary to describe the change which has taken place as a result of the test. Only the characteristic wave lengths need to be measured. The characteristic wave lengths may be defined as the peaks of the curve together with the points of maximum absorption. In colors such as yellows, grays and browns where these parts are not readily observed, the wave lengths taken for measurement are those which show the maximum separation between the two curves. Usually three wave lengths are taken for measurement. The procedure is as follows:

White porcelain plate is used as a standard.

The untreated and treated parts are measured on the same sample, using a white background.

The figures of the untreated portion of the cloth are then compared with those of the treated part, wave length for wave length, according to the following formula.

Let A = Untreated part
B = Treated part
C = Relative reflectance

$$C = \frac{\text{Log}\,\frac{100}{A}}{\text{Log}\,\frac{100}{B}} \times 100$$

In this manner a perfect match may be defined graphically as a straight line having the value of 100. Any deviation from this value indicates a difference in color. If the values are less than 100, the color is darker, if the values are greater than 100, the color is lighter.

Further to summarize these figures, the sum of the difference from 100 at the three wave lengths regardless of sign is called "Color Difference." The relative reflectance at the maximum absorption point is interpreted as fading in the gray scale, either light or dark.

* The Spectrophotometer in the Textile Industry. Monego & Von Bergen, Am. Dye. Reptr., Jan. 3, 1943.

Using the terms Color difference, and relative reflectance in describing a change in color, the minimum perceptible color difference with colors as blues, greens, reds, violets and some orange range from:

101.5—102 Relative reflectance
5.0— 8 Color difference
or 98— 99 Relative reflectance
5— 8 Color difference

Colors as browns, greys and yellows:

102—106 Relative reflectance
5— 20 Color difference

In this case the figures are greatly influenced by the depth of shade, the lighter colors having the higher readings.

Thus by measuring the degree of separation between the treated and untreated part of the color curve, the chemist can specify the results of the test simply and accurately.

(To be continued)

TEXTILE RESEARCH INSTITUTE AND AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS TO CO-ORDINATE THEIR RESEARCH PROGRAMS

AN understanding has been reached, by representatives of the American Association of Textile Chemists and Colorists and of the Textile Research Institute, at a recent meeting, to avoid any danger of duplication of effort by discussing with one another new research projects to determine any possible interference.

The Textile Research Institute proposes to undertake research work, both fundamental and applied, on all phases of textile manufacture. The American Association of Textile Chemists and Colorists is primarily concerned with the wet processing of textiles and is pre-eminent in the development of standard test methods for the use of the textile chemist, dyer, colorist, finisher, converter and consumer of textiles. The two organizations have a common interest in the promotion of knowledge of textiles through research but their programs do not overlap and through voluntary co-ordination will avoid any possibility of duplication.

Accordingly, the industry should not hesitate to provide financial support in behalf of the research work of both organizations in proportion to the interest in their respective programs.

F. S. Blanchard, president of the Textile Research Institute, and Giles Hopkins, chairman of its Applied Research Committee, represented the Institute at the meeting. W. D. Appel, president of the American Association of Textile Chemists and Colorists; Hugh Christison, vice-president; P. J. Wood, past president, and Leonard Little, chairman of its Executive Committee on Research, represented the A.A.T.C.C.

MEMBERSHIP ON MAY 1, 1944

	Senior	*Junior*	*Associate*	*Student*	*1944*	*1943*	*1942*	*1941*	*1940*	*1939*	*1938*	*1937*
Northern New England	319	33	50	0	402	407	398	391	349	327	311	303
Rhode Island	288	27	29	4	348	352	341	337	332	295	284	256
New York	660	59	96	2	817	707	651	606	538	483	451	409
Philadelphia	465	32	53	0	550	513	517	475	447	381	369	326
Piedmont	277	18	31	0	326	286	309	297	293	277	247	238
South Central	75	2	6	0	83	72	80	71	61	63	56	41
Southeastern	110	8	19	4	141	146	175	142	137	133	109	55
Mid West	176	8	25	0	209	198	194	193	180	157	158	147
Student Sections				20	20	56	117	80	59	51	57	41
No Section	93	45	12	1	151	122	82	87	80	71	65	55
	2,463	232	321	31	3047	2859	2864	2679	2476	2238	2107	1871
Corporate members					184	82	77	33	33	32	30	30
			Totals		3231	2941	2941	2712	2509	2270	2137	1901

Members at present in the armed services are counted above only if subscribing to Reporter and Year Book.

CALENDAR OF COMING EVENTS

Meeting, New York Section, Downtown A. C., 19 West St., New York City, June 9, 1944. (Business Meeting). Henry Hird, Samuel Hird & Sons, will show the following color films: "Desert Life," "Packhorse Trips in the Canadian Rockies" and "Fishing and Hunting."

Outing, Rhode Island Section, Pawtucket Golf Course, Pawtucket, R. I., June 9, 1944. Golf tournament and Rhode Island Clambake. Dinner will be served only to those with paid reservations.

Annual Outing, Philadelphia Section, Cedarbrook Country Club, June 16, 1944

Meeting, South Central Section, June 17, 1944. Meeting —5:00 P.M.; Dinner—7:00 P.M.. Speakers: A representative of Dow Chemical Co., "Microbial Control in the Textile Industry"; Jack Anderson, Peerless Woolen Mills, "Highlights on South America and How South American Wool Has Fitted into the American War Effort."

Meeting, Piedmont Section, Robert E. Lee Hotel, Winston-Salem, N. C., June 17, 1944. Speaker: Dean Malcolm Campbell, Textile Dept., North Carolina State College.

Outing, Mid-West Section, Lake Lawn, Delavan, Wisconsin, June 24, 1944.

Meeting, Southeastern Section, Callaway Institute, La Grange, Ga., September 9, 1944 (Tentative).

Annual Meeting, Hotel Claridge, Atlantic City, N. J., October 12, 13 and 14, 1944. Auspices of Philadelphia Section.

A. P. HOWES
Publisher

MYRON D. REESER
Advertising Manager

AMERICAN DYESTUFF REPORTER

LOUIS A. OLNEY, D.Sc.
Directing Editor

NORMAN A. JOHNSON, B.T.C.
Managing Editor

VOLUME 33 | JUNE 5, 1944 | NUMBER 12

Howes Publishing Company Acquires "Textile Colorist"

Publishers' Statements

UPON my recent return to the office from an extended trip to Mexico, I was advised by Howard S. Neiman, Editor and Publisher of *Textile Colorist,* a good friend—and friendly competitor—of many years' standing, that the time had come, at long last, when, for personal reasons, he felt that he should dispose of the magazine.

Accordingly, I agreed to buy it for Howes Publishing Company, who are also publishers of *Knit Goods Weekly.* The formal transfer of ownership is effective as of May 1st of this year. As yet Howes Publishing Company has no definite plans affecting the new property, but for the next few months it will be published as in the past without change or alteration in format, policy, or circulation.

In the meantime, we earnestly bespeak the continued friendship of the many advertisers and subscribers of *Textile Colorist* who have supported it so loyally through its long years of faithful service to the textile processing industry.

A. P. HOWES

* * *

A PERSONAL STATEMENT

The introduction of synthetic coal-tar dyes into the commercial markets in the 1800's created considerable consternation among dyers, who were familiar with only the old natural dyes and who, hence, were ignorant of the new dyeing methods required for the proper application of these invaders into the dyeing industry.

It was evident that some means should be adopted whereby dyers might be promptly and accurately advised of the properties and proper dyeing methods for these new synthetics, and to accomplish these desirable results Dr. M. Frank published the first issue of the *Textile Colorist* on January 1, 1879.

The *Textile Colorist* is the oldest periodical in the world devoted exclusively to the processing treatment of textiles and its columns for the past sixty-five years are among the most complete extant records of the history of the coal-tar dyeing industry.

Howard S. Neiman

Shortly after my graduation from Lehigh University in 1888, I joined the laboratory staff of the Albany Coal Tar Dye and Chemical Company, Albany, New York, the second largest dye manufacturing company in the United States and producers of a number of the then known coal tar dyes including Nigrosine, Induline, Bismark Brown, Chrysoidine, Magenta, a number of basic blues and basic violets, as well as a number of acid-dyeing yellows, oranges and reds.

In 1890 the stock of the above mentioned company was purchased by William J. Matheson & Co., Ltd., sole United States agents for Leopold Cassella & Co., Frankfurt-on-Main, Germany, and I was appointed general manager and

superintendent, a position I retained for about five years until the factory was moved to and consolidated with the other factories of William J. Matheson & Co., Ltd., at Ravenswood, Long Island, New York.

I was then appointed technical director of the company, being in charge of their laboratories in this country and the practical application of the rapidly increasing number of new dyes of Leopold Cassella & Co. In this capacity I made numerous trips to Europe in order to study their methods of application in the European mills for the purpose of introducing them into the mills of this country.

I held this position for a number of years and then resigned to accept a similar position with H. A. Metz & Co., sole agents for Meister, Lucius and Bruening Co. of Germany, and finally retired from active participation in the practical application of dyes. My personal activities and interest in the dyeing industry have thus extended over a period of fifty-six years, a record surpassed by few, if any, in this country.

In the early 1900's, Mr. Emil Frank, son of the founder and then owner of *Textile Colorist,* asked me if I would accept the editorship and general supervision of the publication because of my experience and knowledge of the industry and I accepted, a position I have retained ever since.

In 1923 I purchased the *Textile Colorist* from the estate of Emil Frank and have published and edited it since that date.

I mention these personal items in order that my friends may understand the reasons for my disposal of the publication as I have.

During its existence the *Textile Colorist* has had imitators and will probably have them in the future, but they have all passed, or will pass, into that cemetery whose graves are always open to receive the emaciated bodies of those who have no originality of their own but who endeavor to prosper upon the successful efforts of others.

With the exception of these transient vampires, the *Textile Colorist* was alone in the textile field until the appearance, in 1917, of the AMERICAN DYESTUFF REPORTER and the subsequent organization of American Association of Textile Chemists and Colorists in 1920 and the appointment of the AMERICAN DYESTUFF REPORTER as its official publication.

It was at once evident to both the publisher of the AMERICAN DYESTUFF REPORTER and to me that there could be no real competition between the two publications.

The AMERICAN DYESTUFF REPORTER would be devoted largely to the valuable papers presented to the Association, without which they would have no publicity, while the *Textile Colorist* continued to print special articles written for it by experts in this country and in foreign countries, together with reviews of and transcripts from foreign publications which might not otherwise reach the processors in this country. Hence, the relations between the AMERICAN DYESTUFF REPORTER and myself have always been of the most pleasant and helpful character.

It is natural that my long association with the *Textile Colorist* should have given it a sentimental value to me and the hope that when I decided for personal reasons to pass it from my ownership it would reach someone who had my respect and confidence.

What becomes of the publication after I no longer own it is beyond my control but I wanted to feel that if the new owner should decide to terminate it, they would at least give it a decent burial.

It was natural, therefore, that I should approach those whose friendship I honor and in whose integrity I trust—the publishers of the AMERICAN DYESTUFF REPORTER—feeling assured that whatever final disposition they might make of the *Textile Colorist* would be for the best interests of the textile industry.

I would that I could find words to express my appreciation of the many kindnesses that have been shown me by the many, many friends I have found during my extended association with the textile industry, friendships which do not terminate here, but will last as long as life itself.

I trust that the advertisers and subscribers of the *Textile Colorist* will extend to the new owners the same helpful support that they have extended to the publication in the past and which enabled the publication to be worthy of their consideration and good will.

HOWARD S. NEIMAN

• BOOK REVIEWS •

Handbook of Chemistry **(Fifth Edition). Compiled and edited by Norbert Adolph Lange, Ph.D., assisted by Gordon M. Forker, B.S. (Chem. Eng.) with appendix of mathematical tables and formulas by Richard S. Burington, Ph.D. 2092 pages, 5⅜ x 7¾ Fabricoid cover. Published by Handbook Publishers, Inc. Sandusky, Ohio. 1944. Price $6.00.**

Eighty-five individuals, for the most part experts in their particular line, have contributed suggestions, as well as criticisms and much text material in the preparation of this book. It really comprises two books in one, as the 271 pages of mathematical data and tables at the end constitute one of the most complete compilations of this type, and is so complete that it is required as a text in many schools. Another valuable feature is the extremely complete index which has 3,600 entries. This new edition carries 546 pages of new composition and many revisions on other pages. The revised list of organic compounds list 6,507 individual compounds, with 12 columns of tabulated properties, including rational formulas.

The scope of this book is so extensive that the individual subjects covered cannot be listed, as the table of contents lists 230 different subjects and tabulations.

The following tables have been introduced for the first time.

Periodic Tables (Denning)
Flammable Liquids
Flame Temperatures
Plastics
Fluorescence of Chemicals, Minerals and Gums
Water for Industrial Purposes

Emulsion Technology. **(Theoretical and Applied). Including the Symposium on Technical Aspects of Emulsions by a group of 20 contributing editors. 290 pages.**

Illustrated with numerous graphs and figures. Published by Chemical Publishing Company, Inc., Brooklyn, N. Y. 1943. Price $5.00.

This volume contains the papers read at the second symposium held by the British Section of the International Society of Leather Trades Chemists.

It is a timely and practical book which discusses the new developments in emulsions and the outstanding role they are playing in industry.

Many specialists, in various lines of industry and science, have contributed authoritative information to this symposium.

It covers the theory and use of emulsions and emulsifiers in agriculture, road-making, food, rubber, leather, wool, paint and varnish and other industries. Much valuable data, concerning the equipment and techniques used in the manufacture of emulsions, are included.

The comprehensive list of commercial emulsifying agents and the numerous formulae of commercial emulsions will be helpful to the beginner as well as to the specialist.

This unique assembly of data and technique of the scientific and industrial phases of emulsions should prove of particular interest to all those concerned with the investigation, production and utilization of emulsifiers and emulsions.

TRADE NOTES • NEW PRODUCTS

(Above) Technical Service Laboratory

(Right) Development Laboratory

(Above) Research Laboratory

• NAT'L STARCH PRODUCTS' NEW LABORATORIES

Shown in the photographs are the three main units of National's extensive new laboratories at 270 Madison Avenue, New York. At the same location, but not pictured are their Textile, Resyn Adhesives and Training laboratories, as well as small capacity pilot plants for both Adhesives and Starch Divisions.

The laboratory installations are brand-new and a great deal of additional testing equipment of the latest design is in evidence throughout.

• CHEMICAL INDUSTRY, FIFTH WAR LOAN

The Chemical Industry Committee of the Commerce and Industry Division of the War Finance Committee for New York held a luncheon meeting recently at the Uptown Club, at 60 East 42nd Street, at which Charles S. Munson, president of the Air Reduction Company and Chemical Industry chairman, outlined plans for 100 per cent cooperation by his group in support of the Fifth War Loan.

William E. Cotter, director of the Commerce and Industry Division, pointed out that the chemical industry had sold over 100 million dollars in War Bonds during the Fourth War Loan, and that its present highly organized effort should produce results far in excess of that figure for the approaching drive.

Nevil Ford, state chairman of the War Finance Committee for New York, stressed the fact that the Fifth War Loan was likely to be the most important of all the War Bond Drives, not only because of the huge sum needed by the government to finance the impending invasion, but because our fighting men all over the world would measure our support of them by the zeal with which we supported the Fifth War Loan.

• AVCONIT NO. 4

An improved size or treatment for processing rayon hosiery yarns known as Avconit No. 4, has been developed by the Textile Research and Chemical Research Departments of the American Viscose Corporation. The new product will be manufactured and distributed by the Atlas Powder Company, Wilmington, Del.

Avconit No. 4 is a synthetic wax blend, which is said to be solvent-soluble and applied through this medium. It is white in color and does not discolor upon repeated heatings in solution with solvent. Another feature of the product is its high melting point, which facilitates handling under high temperature conditions.

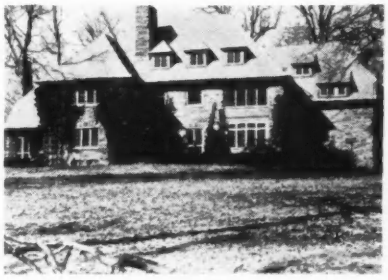
Tests are said to show that Avconit No. 4 allows yarns to be handled more easily in the throwing plant. Because of its high degree of self-emulsifiability, which greatly increases ease of scouring, it is particularly adaptable to the one-bath method of scouring and dyeing.

• DU PONT APPOINTMENTS

E. I. du Pont de Nemours & Co., Inc., announces the appointment of J. Carl Schmidt as manager of the Philadelphia Sales Office of the Dyestuffs Division and Walter G. Hamlen, Jr., as assistant manager. Guy H. Newcomb, former manager, has been relieved at his request, but will continue his connection with the Philadelphia office in an advisory capacity.

• TEXTILE RESEARCH INSTITUTE PURCHASES ESTATE

Announcement of the purchase of the Morton Estate at Princeton, N. J., by the Textile Research Institute, Inc. was made at the meeting of its board of directors held May 18 at Princeton.



The Morton Estate, Princeton, N. J.

As soon as the necessary changes can be made in the building, the fundamental research activities of the Textile Foundation, now located at the Bureau of Standards, Washington, D. C., will be housed in the Institute's property at Princeton and will continue under the direction of Dr. Milton Harris, who is director of

fundamental research for both the Foundation and the Institute.

The administrative offices of the Textile Research Institute, Inc. will continue, for the time being at least, to be located at 10 E. 40th Street, New York, N. Y.

● **RESEARCH CONSULTANT**

Dr. C. N. Andersen, organic chemist and authority on germicides and antiseptics, engaged for the last 17 years in important research work for Lever Brothers, has been retained by Puratized, Inc., as that company's research consultant, George Gallowhur, president of the Puratized concern, announced recently.

Dr. Andersen has issued in his name forty-one patents covering germicides. He will work for Puratized, Inc., a subsidiary of the Gallowhur Chemical Corporation,

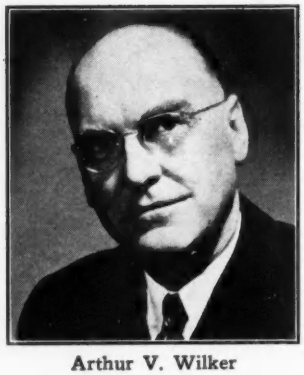
Dr. C. N. Andersen

in the formulation of new compounds for the protection of fabrics and other materials from the attack of germs and mildew-forming fungi.

Dr. Andersen received a B.S. degree from the University of Pennsylvania in 1921 and a Ph.D. from Columbia in 1924.

● **ELECTED PRESIDENT, NATIONAL CARBON**

Arthur V. Wilker has been elected president of National Carbon Company,



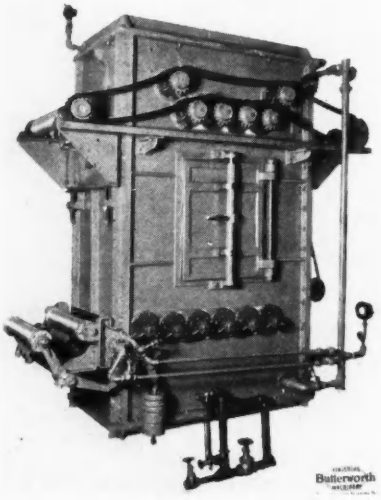
Arthur V. Wilker

Inc., and Canadian National Carbon Company, Ltd., units of Union Carbide and Carbon Corporation. Mr. Wilker holds degrees from Baldwin Wallace College and Case School of Applied Science. After spending a year as head of the department of chemistry at the University of Evansville, he became associated with National Carbon Company in 1910. Continuously since that time, with the exception of three years as head of the department of chemistry at Baldwin Wallace College, of which at present he is a trustee, he has been responsible for production and important research work in the manufacture and use of carbon and graphite products, including the well-known "Eveready" radio batteries and flashlights.

● **LABORATORY AGER**

H. W. Butterworth & Sons Company announce the recent development and construction of a laboratory ager to be used as a hydrosulfide machine. It may also be used to convey samples of various synthetics for a steaming process.

Samples for developing are conveyed through the machine on an endless blanket. Blanket is equipped with an adjustable tension device.



Laboratory Ager

The construction of the bottom of the ager, which has a steam coil and the necessary baffle plates, insures against splash from the boiling liquor coming in direct contact with thet cloth. A steam chest at the roof of the machine eliminates any possibility of condensation dropping on the cloth.

The Butterworth laboratory ager can be heated with dry or saturated steam. Top rolls in the ager are mounted and driven in anti-friction bearings. Lower rolls are mounted in anti-friction bearings but not driven.

Equipped with a variable drive motor, goods are allowed to remain in the ager from two minutes up to six minutes—the usual time required for various types of vat colors.

● **NEW RESIN LATEX**

Production of a true latex of vinyl chloride resin without using costly and dangerous solvents, a project on which B. F. Goodrich research chemists have been working for 17 years, has been achieved, it was announced recently.

In the new latex, according to William S. Richardson, general manager of the chemical division, the company's Geon resin is dispersed with water, instead of with the flammable and toxic solvents formerly used, some of which are extremely critical as regards supply. It can be adapted to a wide variety of uses in coating textiles, wires and other materials, and in film manufacture, he said.

● **APPOINTED OPERATIONS MANAGER**

E. B. Mathewson, prominent in the textile industry for many years, has been appointed Operations Manager of the North Star Woolen Mill Company and The Lima Woolen Mills Company, W. G. Northup, president of both companies, announced recently.

At North Star, Mr. Mathewson's duties will be concerned principally with plant management, engineering and administration as well as coordinating the operations of North Star in Minneapolis with its wholly-owned subsidiary, The Lima Woolen Mills Company in Lima, Ohio.

● **"E" AWARD**

Recognition of its outstanding production of vat dyes and waterproofing compounds used on combat clothing, tentage, equipment, camouflage cloth, as well as large-scale output of detergents, wetting agents, dye powder for smoke bombs and radio equipment, was made recently when the employees of the Grasselli Works of the General Aniline & Film Corporation, Linden, N. J., were awarded the Army-Navy "E."

The pennant was presented by Lt. Col. James V. Demarest, director of procurement, Jersey City Quartermaster Depot. Dr. Paul Strubin, works manager, accepted it for the company. George W. Burpee, president of General Aniline & Film Corporation, served as master of ceremonies. The "E" pin citation was read by Lt. Lawrence P. Mooney, U.S.N.R., and the pin acceptance speech was made on behalf of approximately 2,000 employees by Adam P. Wegryn, president of the General Aniline Employees Organization.

Without any substantial increase in plant facilities the Grasselli Works of General Aniline is now producing at more than twice its pre-war rated capacity, the company said.

SANDOZ PRESENTS *the color achievement of the month*

BY CHATHAM

A warm, comfortable color, and gay as a June bride, adds distinction and sales appeal to this product of Chatham Mills.

Sandoz, a leader in dyes, congratulates The Chatham Manufacturing Company, a leader in blankets, for raising once more "The American Standard For Bedtime Comfort".

Sandoz is especially quick to cooperate in new textile developments because the entire Sandoz organization is accustomed to the policy of "thinking ahead with textiles." Out of Sandoz' laboratories have come such exclusive developments as its well-known Fast-to-Light Milling Colors... Cerol TGI... and Metomega Chrome Colors.

The latter—in a full range of colors—are especially useful today. Two advantages save the precious time of skilled personnel. Metomega Chrome Colors reduce boiling time by as much as 50%. Secondly, formulas can be checked after only 15 minutes, speeding up the development of correct shading.

To assist your firm in obtaining the full usefulness of Sandoz' acid, chrome and direct dyes, and auxiliary chemicals for all natural and synthetic fibres, application laboratories are at your service in New York, Boston, Philadelphia, Charlotte, Los Angeles and Toronto. Stocks are carried in those cities. Other branches in Chicago, Paterson and Providence.

Another "Color Achievement of the Month"—next month—will feature another Sandoz customer among the leaders of the Textile Industry.

SANDOZ CHEMICAL WORKS, INC., 61 VAN DAM STREET, NEW YORK 13, N. Y.

SANDOZ *thinks ahead with textiles*

SANDOZ

SOLVAY*

...KEYED TO TODAY AND TOMORROW

Today... Solvay's large facilities are supplying alkalies which are used in the over-all requirements for the mass production of pre-fabricated war housing. In the history-making months to come, Solvay will continue to make its important contributions to the war with highest quality alkalies and related products.

Tomorrow... New housing methods will offer a healthy, more enjoyable way of life to people everywhere. Solvay, with its broad background of long experience and continuous research, will keep in step with all new housing developments—supplying quality alkalies to America's great industries.

SOLVAY

**The Solvay Process Company employs salt, limestone and ammonia to make Soda Ash, from which basic material Caustic Soda and other alkalies are derived*

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AMMONIUM BICARBONATE
AMMONIUM CHLORIDE
PARA-DICHLOROBENZENE
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CHLORINE

CAUSTIC SODA
POTASSIUM CARBONATE
SODIUM NITRITE • SALT
CALCIUM CHLORIDE
MODIFIED SODAS

SOLVAY SALES CORPORATION
Alkalies and Chemical Products Manufactured by The Solvay Process Company
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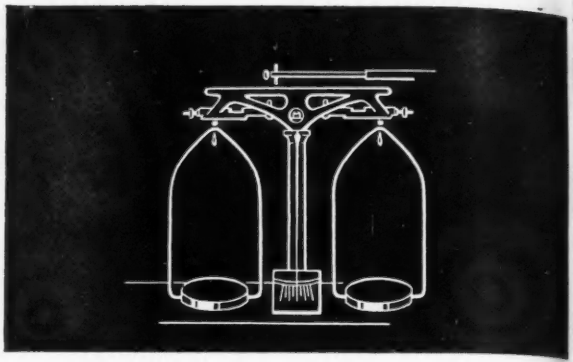

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- Level Dyeing
- Excellent light fastness

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Manufacturing Chemists

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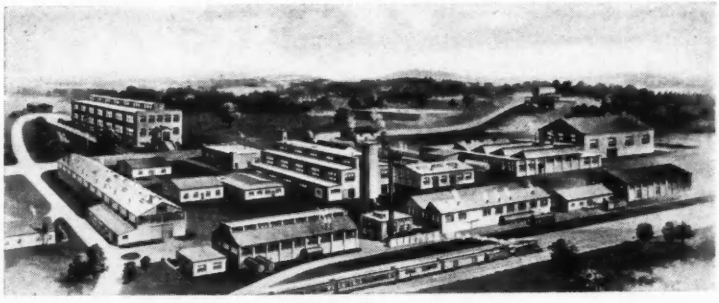
TEXTILE CHEMICALS



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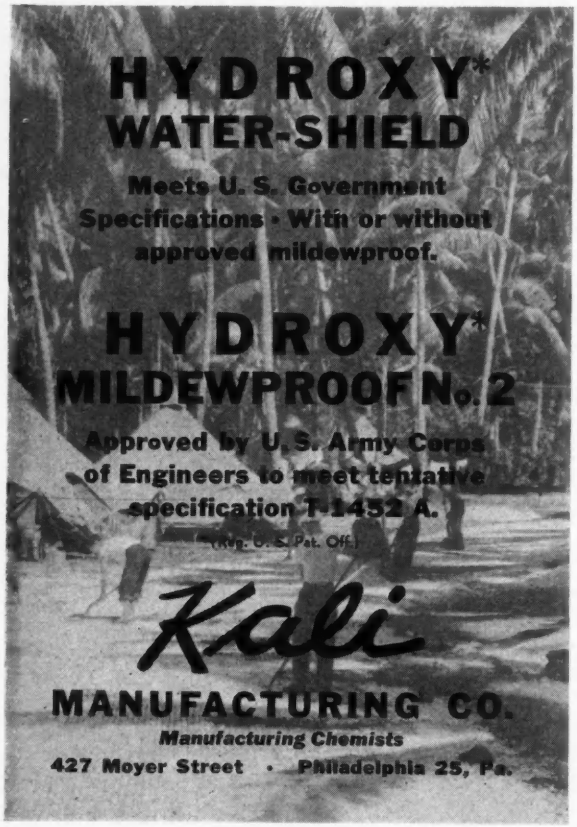
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Meets U. S. Government Specifications · With or without approved mildewproof.
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36 Years of Satisfactory Results

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"VIRGINIA" (SODIUM) HYDRO

A dependable Hydrosulfite for Vat Dyeing and Stripping.

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3. Easily and Quickly soluble

Packed in 250 lb. *airtight* containers.

"VIRGINIA" (LIQUID) SO_2 THE IDEAL ANTICHLOR

The "Old Reliable" of the finishing plant. Low concentrations...

— remove active chlorine
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— eliminate excessive washing

Constant make-up by continuous flow to the pit. Shipped in steel cylinders containing 150 lb. net weight.

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Dependable, speedy and economical de-sizing . . . Our technical staff always at your service.

● *for cottons rayons and mixed goods*

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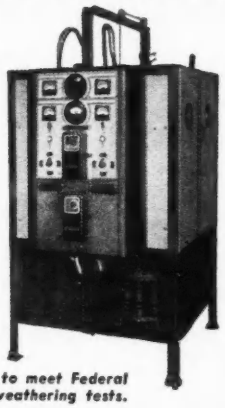
WEATHERING TEST FOR TEXTILES

Weathering effects of sunlight, rain, heavy dew and thermal shock reproduced in the laboratory at an accelerated rate that reduces years of actual weathering to a few days of testing in the —

ATLAS TWIN-ARC WEATHER-OMETER

The Twin-Arc Weather-Ometer has full automatic control of light and water periods. The Atlas Cycle Timer unit can be set to reproduce any combination of weathering conditions. A direct reading thermal regulator, automatic shut-off switch and a running time meter is included on the control panel. After setting exposure cycle on the control panel the Weather-Ometer is safe to be left in continuous operation over night without attention except to replace carbons once in 24 hours.



The Atlas Weather-Ometer is required to meet Federal Specifications demanding accelerated weathering tests.

ATLAS ELECTRIC DEVICES COMPANY
361 W. Superior Street, Chicago 10, Illinois

Originators and sole manufacturers for over a quarter of a century. . . . Weather-Ometers, Launder-Ometers, Fade-Ometers are the accepted standard accelerated testing machines all over the world.

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HASTINGS IRISOL R S

COLOUR INDEX 1073

Hastings Irisol RS is a level dyeing acid violet of outstanding fastness to light. It is recommended for the dyeing of ladies' dress goods, carpet yarn, knitting yarn, upholstery material, hats, etc.

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ESTABLISHED 1897
Manufacturing Chemists
HASTINGS-ON-HUDSON NEW YORK

• Classified Advertisements •

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $6.25 per column inch or less per insertion.

WANTED: Laboratory assistants for our New England plants. State experience, education and salary expected. Write to W. H. Cady, U. S. Finishing Co., Norwich, Conn.

POSITION WANTED: Salesman, 36 years old, 15 years experience in all phases of textile dyeing and processing. Textile school graduate. Draft status 2-B. Location immaterial. Full details on request. Box 557.

WANTED: Experienced dyer, 30 to 40 years of age, for skein and package dyeing of silk, nylon, cotton, and other synthetic threads. Chemistry background and education important. Capable of handling men in dyehouse and supervising laboratory work. Plant in New England. Box 558.

WANTED: Sales Representative by manufacturer of dyes and auxiliary products. Sales office and laboratory in Charlotte, N. C. Give draft status and details of experience. Box 559.

POSITION WANTED: Graduate Chemist, 15 years experience in dyeing and finishing plant control and development. All types of dyestuffs and fibres. Broad experience in development of specialty resin finishes and coatings. Thoroughly familiar with all types of textile processing machinery and equipment. Desires position in technical service division of progressive chemical concern. Available June 15th. Box 560.

WANTED: Chemist. Permanent routine work in southern textile laboratory. State age, education, draft status, previous experience and salary desired. Box 561.

WANTED: Textile chemist with finishing plant experience for position with progressive chemical manufacturer, as assistant head of application laboratory. Please state education, experience, age, draft status and salary. Box 562.

POSITION WANTED: Textile chemist, over 15 years of practical experience with leading dyeing and finishing organizations as research-chemist desires connection with progressive organization. Experienced in formulating special finishes for the textile, metal and leather processing industries. Draft exempt. Box 563.

WANTED: Textile chemist for dyeing and finishing plant. Location—Rhode Island. Experience in testing of chemicals and dyestuffs necessary and knowledge of heavy starch finishes and coatings with pyroxylin lacquers is desirable but not essential. Box 564.

POSITION WANTED: Textile engineer, 30 years of age, textile school graduate, four years experience as colorist and chemist on cotton and all synthetic fibers, six years on research and development of special fabrics and finishes. Desires to contact progressive organization now on essential work, with post-war possibilities. Box 565.

WANTED: Will purchase Naphthol AS-DB at current market prices from anyone who has same to offer. Send full information Box 566.

WANTED: For well-paid position with substantial specialty manufacturer, a chemist of proven ability, thoroughly familiar with practical textile manufacture as well as with organic chemistry and non-routine analysis. Must be capable of independent judgment, creative, and able to cooperate with others. Please state history and attach snapshot. All replies will be held in strict confidence. Box 567.

WANTED: By plant located in New England, graduate dye chemist familiar with dyeing all textiles. Must have successful record with broad experience. Permanent position with good opportunity. Salary commensurate with ability. State education and experience in detail. Box No. 568.

NOTE

Essential employees need release statement. Employees who are to be hired for critical occupations need release statement and U. S. E. S. consent.

Eighth Edition

CHEMICAL TECHNOLOGY OF THE FIBERS

By LOUIS A. OLNEY

Professor of Chemistry and Dyeing

LOWELL TEXTILE INSTITUTE

$2.50 per copy

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★ **improve quality**
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Laurel Hosiery Finishes impart soft, smooth appearance, assure greater freedom from snags. Provide proper lubrication and finish needed to protect your fibers, increase elasticity, help eliminate wrinkles, give the longer wear so important today. Seamless or full-fashioneds . . . cotton, rayon or combinations, you can get Laurel laboratory-controlled and mill-tested finishes that exactly fit your job, simplify your processing and step up your production.

Over 35 years' experience in preparing textile finishes for leading mills enables Laurel Technicians to make practical recommendations, help meet Government specifications. Send for a trial order and formula today. Available for immediate delivery.

Hydrocop • Laurel 3B Softener • Hetrosol • Dull Finishes • Water Repellents • Laurel Mildant "A"

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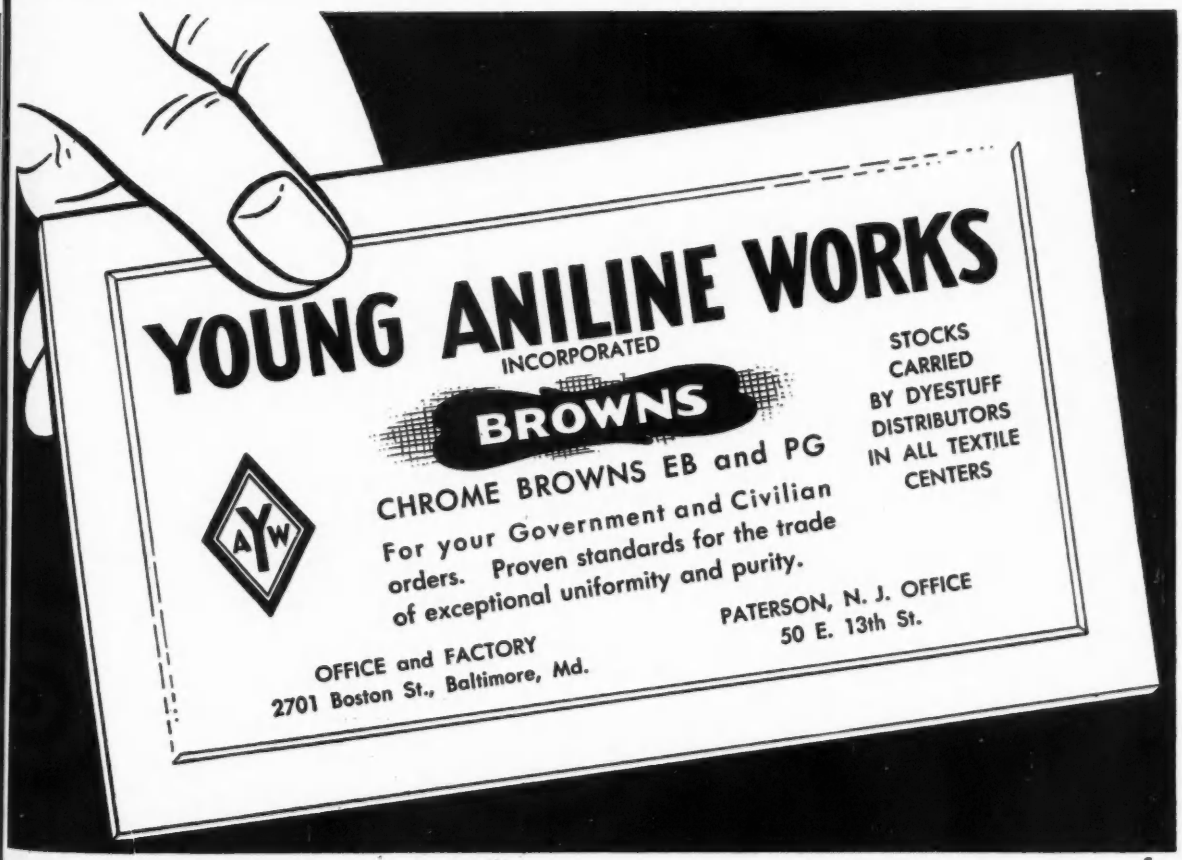
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To meet government specifications for mildewproofing sleeping bags, webbing, tentage, shoe linings, tapes, mosquito netting, etc. . . non toxic . . non irritating.

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For flameproofing uniform cloth, tentage, felts, etc.

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Produces a water-repellent finish on uniform cloth, overcoatings, and other military fabrics . . . used in a single bath treatment with Fungicide G to impart water-repellency and mildew resistance . . . used in a single bath treatment with Arko Fire Retardant to produce water-repellency and fire-resistance.

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THE ROLE OF CHEMISTRY In the Development of Textiles

NO. 6 OF A SERIES

AMERICAN DYESTUFF PIONEER

Dr. Edward Bancroft (1744-1821) was the first exporter of a finished dye product from America. He was also a Fellow of the Royal Society of London, and a friend of Benjamin Franklin and of Joseph Priestley, the famous English chemist. He was born in Westfield, Massachusetts, but lived most of his life in England.

On a visit to America in search of dyestuffs in 1770, he made his most valuable discovery — Quercitron, the powdered bark of the black oak. It was not only employed as a color itself but as a base for other colors. In 1785 the British Parliament granted him a 7-year patent for its exclusive sale but in 1799 he was refused a renewal. Quercitron became available for everybody but immediately rose in price.

Bancroft's investigations over a long period led to the first book on dyestuffs written by an American — his famous "Experimental Researches Concerning the Philosophy of Permanent Colors" which was recognized as an authority by the great chemists of the time.

From a commonplace substance, Bancroft, the chemist, evolved a significant contribution to the development of textiles, for Quercitron was in use until World War I. In the same way, the textile chemist of today gives ordinary substances almost magical powers.

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Manufacturing Chemists for the Textile Industry — translating the discoveries of the laboratory into practical advances in the dyeing and finishing of yarns and fabrics.

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Sound the Alert!

MANAGEMENT
LABOR

—for the 5th War Loan drive during June and July. The need for the 5th War Loan is immediate, crucial. For impending events may make the 5th the supreme financial effort of the war.

The U. S. Treasury has set the overall goal at $16,000,000,000 — $6,000,000,000 from individuals alone. This is the biggest sum ever asked of the American people—*and it must be raised.*

That's why the U. S. Treasury asks Management and Labor to sit down together and organize—NOW!

For organization—good organization—has been responsible for the excellent showing of the payroll market. And its most important single superiority has been personal solicitation—desk to desk, bench to bench, machine to machine personal solicitation. 71% of all persons on payroll deductions were solicited for the 4th War Loan.

Now, to personal solicitation, add the sales incentive of a definitely established plant quota. Build your campaign around a quota plan. Set up departmental goals. Stress percentage of participation figures. Stimulate group enthusiasm.

In planning your quota campaign, work in close cooperation with the Chairman of your War Finance Committee. Everything is set to make the 5th War Loan drive a huge success—with your help!

(Note: You've read this message. If it doesn't apply to you please see that it reaches the *one* person who can put it in action!)

Here's the Quota Plan:

1. Plant quotas are to be established on the basis of an average $100 *cash* (not maturity value) purchase per employee.
2. Regular Payroll Savings deductions made during the drive accounting period will be credited toward the plant quota.
3. 90% of the employees are expected to contribute toward raising the cash quota by buying extra 5th War Loan Bonds: 1—Outright by cash. 2—By extra installment deductions. 3—By extra installment deductions plus cash.

Example: **JOHN DOE Mfg. Co.** — 1,000 Employees

1,000 employees x $100 Regular Payroll deductions during the eight weekly payroll Accounting Periods of June and July = $100,000 Cash Quota

30,000
$70,000 (to be raised by sales of extra Bonds to at least 900 employees)

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Effective either for stripping or for level dyeing when working with many of the vat type dyes.

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Economical and labor saving.

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(SODIUM SULPHOXYLATE FORMALDEHYDE)

Assures satisfactory results in both discharge and application printing of vat and direct colors.

This is because DISCOLITE is prepared under strict laboratory control, and so is absolutely free from harmful impurities, resulting in extreme cleanliness in handling.

Our technical service department is at your command in connection with the use of DISCOLITE and other Royce Textile Chemicals.

The uniform strength and purity of DISCOLITE are important for long runs and maximum efficiency. Build your formulas on DISCOLITE.
It rewards confidence.

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